

# Operating Instructions

Diesel engine  
12 V 1600 R50

MS15025/00E



*Power. Passion. Partnership.*

Printed in Germany

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This handbook is provided for use by maintenance and operating personnel in order to avoid malfunctions or damage during operation.

Subject to alterations and amendments.

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# 1 Safety

## 1.1 General conditions

### General

In addition to the instructions in this publication, the applicable country-specific legislation and other compulsory regulations regarding accident prevention and environmental protection must be observed. This state-of-the-art engine has been designed to meet all applicable laws and regulations. The engine may nevertheless present a risk of injury or damage in the following cases:

- Incorrect use
- Operation, maintenance and repair by unqualified personnel
- Modifications or conversions
- Noncompliance with the Safety Instructions

### Correct use

The engine is intended solely for use in accordance with contractual agreements and the purpose envisaged for it on delivery. Any other use is considered improper use. The engine manufacturer accepts no liability whatsoever for resultant damage or injury in such case. The responsibility is borne by the user alone.

Correct use also includes observation of and compliance with the operating instructions and maintenance and repair specifications.

### Modifications or conversions

Unauthorized modifications to the engine represent a safety risk.

MTU will accept no liability or warranty claims for any damage caused by unauthorized modifications or conversions.

### Spare parts

Only genuine MTU spare parts must be used to replace components or assemblies. MTU accepts no liability whatsoever for damage or injury resulting from the use of other spare parts and the warranty shall be voided in such case.

### Reworking components

Repair or engine overhaul must be carried out in workshops authorized by MTU.

## 1.2 Personnel and organizational requirements

### **Personnel requirements**

Work on the engine must only be carried out by appropriately qualified and instructed personnel.

Observe the minimum legal age.

Responsibilities of the operating, maintenance and repair personnel must be specified by the operating company.

### **Organizational measures**

This publication must be issued to all personnel involved in operation, maintenance, repair or transportation.

Keep it handy in the vicinity of the engine such that it is accessible to operating, maintenance, repair and transport personnel at all times.

Use the manual as a basis for instructing personnel on engine operation and repair. In particular, personnel must have read and understood the safety-relevant instructions.

This is especially important for personnel who work on the engine only on an occasional basis. These persons shall receive repeated instruction.

Use the Spare Parts Catalog to identify spare parts during maintenance and repair work.

### **Working clothes and protective equipment**

Wear proper protective clothing for all work.

Depending on the kind of work, use the necessary personal protective equipment.

## 1.3 Transport

### Transport

Lift the engine only with the lifting eyes provided.

Use only the transport and lifting equipment approved by MTU.

Take note of the engine center of gravity.

The engine must only be transported in installation position, max. permissible diagonal pull 10°.

In the case of special packaging with aluminum foil, suspend the engine on the lifting eyes of the transport pallet or transport with equipment for heavy loads (forklift truck).

### Setting the engine down after transport

Place the engine only on an even, firm surface.

Ensure appropriate consistency and load-bearing capacity of the ground or support surface.

Never place an engine on the oil pan, unless expressly authorized by MTU on a case-to-case basis to do so.

## 1.4 Safety regulations for startup and operation

### Safety requirements for initial operation

Prior to initial operation of the unit, install the assembly or unit according to the specifications and check the installation according to the MTU specifications.

Before putting the device or plant into operation, always ensure:

- that all maintenance and repair work is completed,
- that all loose parts have been removed from rotating machine components,
- that nobody is in the danger area of moving machine parts.

Immediately after putting the device or plant into operation, make sure that all control and display instruments as well as the signaling and alarm systems work properly.

### Safety requirements for operators

The procedures for cases of emergency must be practiced regularly.

The operator must be familiar with the control and display elements.

The operator must be familiar with the consequences of any operations performed.

During operation, the display instruments and monitoring units must be permanently observed with regard to present operating status, violation of limit values and warning or alarm messages.

The following steps must be taken if a malfunction of the system is recognized or reported by the system:

- inform supervisor(s) in charge,
- analyze the message,
- if required, carry out emergency operations e.g. emergency engine stop.

### Engine operation

The following conditions must be fulfilled before starting the engine:

- Wear ear protection.
- Ensure that the engine room is well ventilated.
- Do not inhale engine exhaust gases.
- Ensure that the exhaust system is free of leaks and that the gases are discharged to atmosphere.
- Mop up any leaked or spilt fluids and lubricants immediately or soak up with a suitable binding agent.
- Protect battery terminals, battery-charger terminals and cables against accidental contact.
- When the engine is running, never release coolant, oil, fuel, compressed-air or hydraulic lines.

### Operation of electrical equipment

When electrical equipment is in operation, certain components of these appliances are electrically live.

Observe the safety instructions for these devices.

## 1.5 Safety regulations for maintenance and repair work

### **Safety regulations for maintenance and repair work**

Have maintenance and repair work carried out by qualified and authorized personnel only.

Allow the engine to cool down before starting maintenance work (risk of explosion of oil vapors).

Before starting work, relieve pressure in systems and compressed-air lines which are to be opened.

Take special care when removing ventilation or plug screws from the engine. Cover the screw or plug with a rag to prevent fluids escaping under pressure.

Take special care when draining hot fluids ⇒ Risk of injury.

When changing the engine oil or working on the fuel system, ensure that the engine room is adequately ventilated.

Allow the engine / system to cool down before starting to work.

Observe the maintenance and repair instructions.

Never carry out maintenance and repair work with the engine running unless expressly instructed to do so.

Secure the engine against accidental starting.

Disconnect the battery when electrical starters are fitted.

Close the main valve on the compressed-air system and vent the compressed-air line when pneumatic starters are fitted.

Disconnect the control equipment from the assembly or system.

Use only proper, calibrated tools. Observe the specified tightening torques during assembly/disassembly.

Carry out work only on assemblies and/or units which are properly secured.

Never use lines for climbing.

Keep fuel injection lines and connections clean.

Always seal connections with caps or covers if a line is removed or opened.

Take care not to damage lines, in particular fuel lines, during maintenance and repair work.

Ensure that all retainers and dampers are installed correctly.

Ensure that all fuel injection and pressurized oil lines are installed with enough clearance to prevent contact with other components. Do not place fuel or oil lines near hot components.

Do not touch elastomeric seals if they have carbonized or resinous appearance unless hands are properly protected.

Note cooling time for components which are heated for installation or removal ⇒ Risk of burning.

When working high on the engine, always use suitable ladders and work platforms. Make sure components are placed on stable surfaces.

Observe special cleanness when conducting maintenance and repair work on the assembly or system. After completion of maintenance and repair work, make sure that no loose objects are in/on the assembly or system.

Before barring the engine, make sure that nobody is standing in the danger zone. Check that all guards have been reinstalled and that all tools and loose parts have been removed after working on the engine.

The following additional instructions apply to starters with beryllium copper pinion:

- Breathing protection of filter class P2 must be applied during maintenance work to avoid health hazards caused by the beryllium-containing pinion. Do not blow out the interior of the flywheel housing or the starter with compressed air. Clean the flywheel housing inside with a class H dust extraction device as an additional measure.

## **Welding work**

Never carry out welding work on the assembly, system, or engine-mounted units. Cover the engine when welding in its vicinity.

Do not use the assembly or system as ground terminal.

Do not route the welding lead over or near the wiring harnesses of MTU systems. The welding current may otherwise induce an interference voltage in the wiring harnesses which could conceivably damage the electrical system.

Remove parts (e.g. exhaust pipes) which are to be welded from the engine beforehand.

## **Hydraulic installation and removal**

Check the function and safe operating condition of tools and fixtures to be used. Use only the specified devices for hydraulic removal/installation procedures.

Observe the max. permissible push-on pressure specified for the equipment.

Do not attempt to bend or apply force to lines.

Before starting work, pay attention to the following:

- Vent the hydraulic installation/removal tool, the pumps and the lines at the relevant points for the equipment to be used (e.g. open vent plugs, pump until bubble-free air emerges, close vent plugs).
- For hydraulic installation, screw on the tool with the piston retracted.
- For hydraulic removal, screw on the tool with the piston extended.

For a hydraulic installation/removal tool with central expansion pressure supply, screw spindle into shaft end until correct sealing is established.

During hydraulic installation and removal, ensure that nobody is standing in the immediate vicinity of the component to be installed/removed.

## **Working on electrical/electronic assemblies**

Always obtain the permission of the person in charge before commencing maintenance and repair work or switching off any part of the electronic system required to do so.

De-energize the appropriate areas prior to working on assemblies.

Do not damage cabling during removal work. When reinstalling ensure that wiring is not damaged during operation by contact with sharp objects, by rubbing against other components or by a hot surface.

Do not secure cables on lines carrying fluids.

Do not use cable binders to secure cables.

Always use connector pliers to tighten connectors.

Subject the device or system to a function check on completion of all repair work.

Store spare parts properly prior to replacement, i.e. protect them against moisture in particular. Pack defective electronic components and assemblies in a suitable manner when dispatched for repair, i.e. particularly protected against moisture and impact and wrapped in antistatic foil if necessary.

## **Working with laser equipment**

When working with laser equipment, always wear special laser-protection goggles ⇒ Heavily focused radiation.

Laser equipment must be fitted with the protective devices necessary for safe operation according to type and application.

For conducting light-beam procedures and measurement work, only the following laser devices must be used:

- Laser devices of classes 1, 2 or 3A.
- Laser devices of class 3B, which have maximum output in the visible wavelength range (400 to 700 nm), a maximum output of 5 mW, and in which the beam axis and surface are designed to prevent any risk to the eyes.

## 1.6 Fluids and lubricants, fire prevention and environmental protection

### Fire prevention

Rectify any fuel or oil leaks immediately; even splashes of oil or fuel on hot components can cause fires - therefore always keep the engine in a clean condition. Do not leave cloths soaked with fluids and lubricants lying on or near the assembly or unit. Do not store inflammable material near the assembly or unit.

Do not weld pipes and components carrying oil or fuel! Before welding, clean with a nonflammable fluid.

When starting the engine with an external power source, connect the ground lead last and remove it first. To avoid sparks in the vicinity of the battery, connect the ground lead from the external power source to the ground lead of the engine or to the ground terminal of the starter.

Always keep suitable firefighting equipment (fire extinguishers) at hand and familiarize yourself with their use.

### Noise

Noise can lead to an increased risk of accident if acoustic signals, warning shouts or noises indicating danger are drowned.

Wear ear protectors in work areas with a sound pressure level in excess of 85 dB (A).

### Environmental protection and disposal

Modification or removal of mechanical or electronic components or the installation of additional components as well as the execution of calibration processes that might affect the emission characteristics of the engine are prohibited by emission regulations. Emission control units/systems may only be maintained, exchanged or repaired if the components used for this purpose are approved by MTU or equivalent components. Noncompliance with these guidelines might represent a violation of the Clean Air Act and involves the termination of the operating license by the emission authorities. MTU does not accept any liability for violations of the emission regulations. MTU will provide assistance and advice if emission-relevant components are intended to be modified. The MTU Maintenance Schedules ensure the reliability and performance of MTU engines and must be complied with over the entire life cycle of the engine.

Use only fuel of prescribed quality to comply with emission limit values.

Dispose of used fluids, lubricants and filters in accordance with local regulations.

Within the EU, batteries can be returned free of charge to MTU FN / MTU Onsite Energy where they are subjected to proper recycling procedures.

### Fluids and lubricants

Use only fluids and lubricants that have been tested and approved by MTU.

Keep fluids and lubricants in suitable, properly designated containers. When using fluids, lubricants and other chemical substances, follow the safety instructions that apply to the product. Take special care when using hot, chilled or caustic materials. When using flammable materials, avoid all sparks and do not smoke.

### Used oil

Used oil contains harmful combustion residues.

Rub barrier cream into hands.

Wash hands after contact with used oil.

## Lead

- When working with lead or lead-containing compounds, avoid direct contact to the skin and do not inhale lead vapors.
- Adopt suitable measures to avoid the formation of lead dust.
- Switch on extraction system.
- Wash hands after contact with lead or lead-containing substances.

## Compressed air

Observe special safety precautions when working with compressed air:

- Pay special attention to the pressure level in the compressed air network and pressure vessel.
- Assemblies and equipment to be connected must either be designed for this pressure, or, if the permitted pressure for the connecting elements is lower than the pressure required, a pressure reducing valve and safety valve (set to permitted pressure) must form an intermediate connection.
- Hose couplings and connections must be securely attached.
- Wear goggles when blowing off components or blowing away chips.
- Provide the snout of the air nozzle with a protective disk (e.g. rubber disk).
- First shut off compressed air lines before compressed air equipment is disconnected from the supply line, or before equipment or tool is to be replaced.
- Unauthorized use of compressed air, e.g. forcing flammable liquids (danger class A1, A11 and B) out of containers, results in a risk of explosion.
- Forcing compressed air into thin-walled containers (e.g. containers made of tin, plastic and glass) for drying purposes or to check for leaks, results in a risk of bursting.
- Carry out leak test in accordance with the specifications.

## Painting

- When carrying out painting work outside the spray stands provided with fume extraction systems, ensure that the area is well ventilated. Make sure that neighboring work areas are not impaired.
- No open flames.
- No smoking.
- Observe fire prevention regulations.
- Always wear a mask providing protection against paint and solvent vapors.


## Liquid nitrogen

- Store liquid nitrogen only in small quantities and always in regulation containers without fixed covers.
- Avoid body contact (eyes, hands).
- Wear protective clothing, protective gloves, closed shoes and protective goggles / safety mask.
- Make sure that working area is well ventilated.
- Avoid all knocks and jars to the containers, fixtures or workpieces.

## Acids and alkaline solutions

- When working with acids and alkalis, wear protective goggles or face mask, gloves and protective clothing.
- If such solutions are spilled onto clothing, remove the affected clothing immediately.
- Rinse injured parts of the body thoroughly with clean water.
- Rinse eyes immediately with eyedrops or clean tap water.

## 1.7 Conventions for safety instructions in the text

<b>DANGER</b> 	In the event of immediate danger. <b>Consequences: Death or serious injury</b> <ul style="list-style-type: none"><li>• Remedial action</li></ul>
<b>WARNING</b> 	In the event of potentially dangerous situations. <b>Consequences: Death or serious injury</b> <ul style="list-style-type: none"><li>• Remedial action</li></ul>
<b>CAUTION</b> 	In the event of dangerous situations. <b>Consequences: Minor injury or material damage</b> <ul style="list-style-type: none"><li>• Remedial action</li></ul>

**Note:** This manual contains highlighted safety warnings in accordance with the US ANSI Z535 standard which begin with one of the signal words listed above depending on the severity of the hazard.

### Safety instructions

1. Read and familiarize yourself with all safety notices before starting up or repairing the product.
2. Pass on all safety instructions to your operating, maintenance, repair and transport personnel.

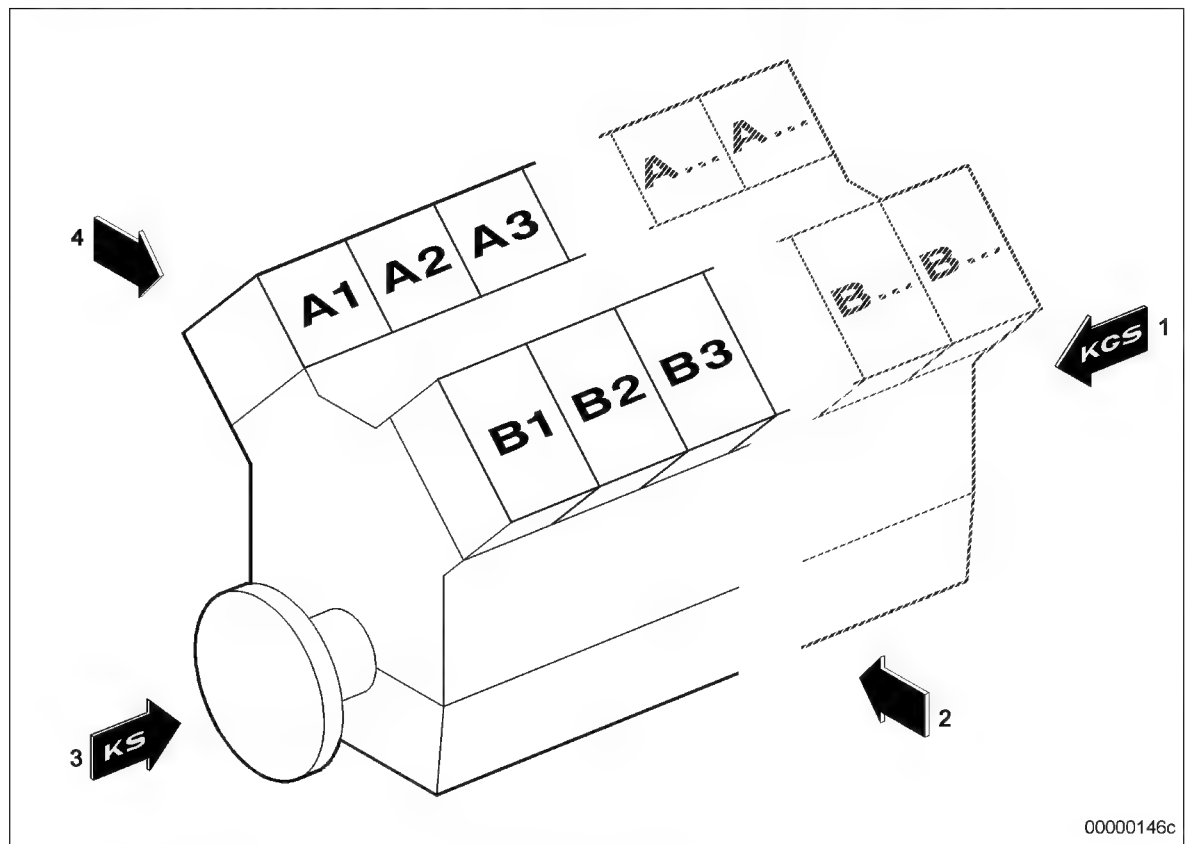
## 2 General Information

### 2.1 Engine side and cylinder designations

Engine sides are always designated as viewed from the driving end (KS).

The cylinders of the left engine side are designated "A" and those of the right side "B" (as per DIN ISO 1204). The cylinders of each bank are numbered consecutively, starting with No. 1 at the driving end of the engine.

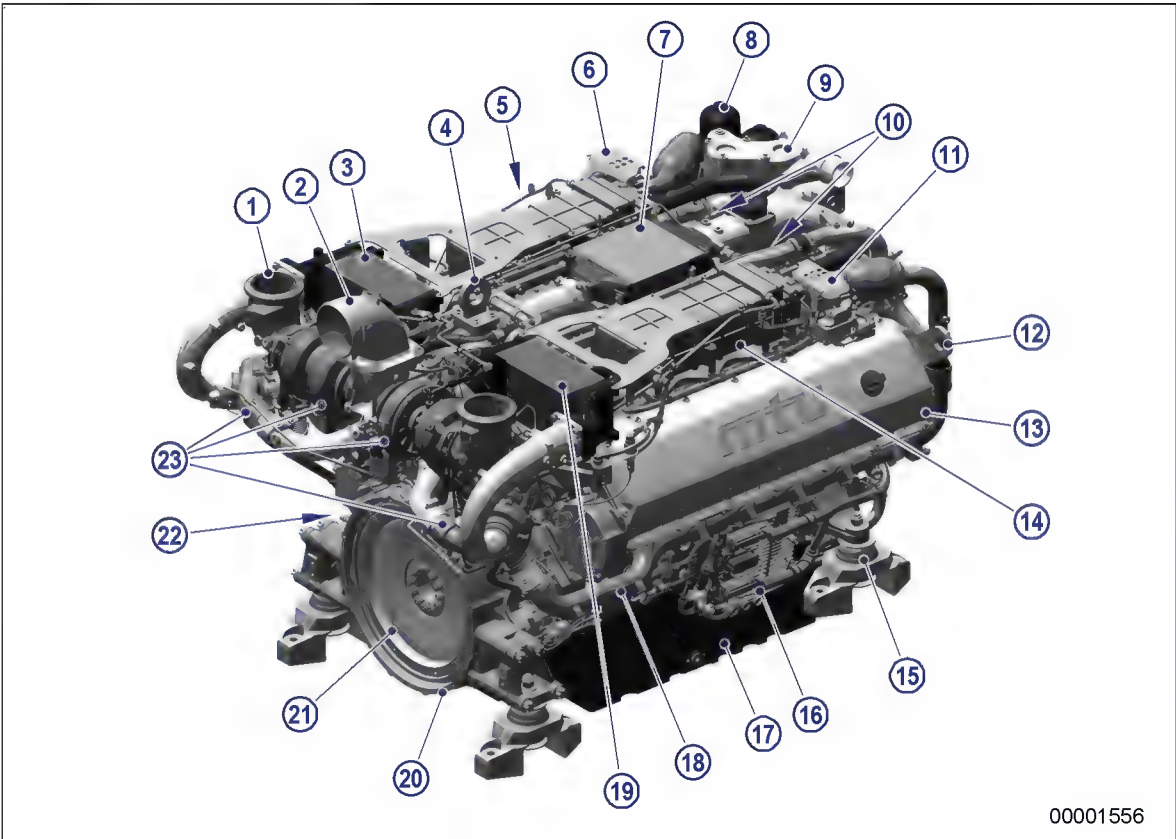
Other components are numbered in the same way, i.e. starting with No. 1 on driving end.



1 KGS = Free end  
2 Right engine side

3 KS = Driving end  
4 Left engine side

## 2.2 Engine layout



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- |                                   |                                    |                         |
|-----------------------------------|------------------------------------|-------------------------|
| 1 Exhaust outlet                  | 9 Thermostat housing               | 17 Oil pan              |
| 2 Air intake                      | 10 Oil filter                      | 18 Exhaust elbow        |
| 3 Intercooler                     | 11 EGR flap in front of EGR cooler | 19 Intercooler          |
| 4 Lifting eye, driving end        | 12 Lifting eye, free end           | 20 Flywheel housing     |
| 5 Oil dipstick                    | 13 Cylinder head                   | 21 Flywheel             |
| 6 EGR flap in front of EGR cooler | 14 EGR cooler                      | 22 Starter              |
| 7 Intercooler                     | 15 Engine mounting                 | 23 Exhaust turbocharger |
| 8 Fuel filter                     | 16 Engine governor                 |                         |

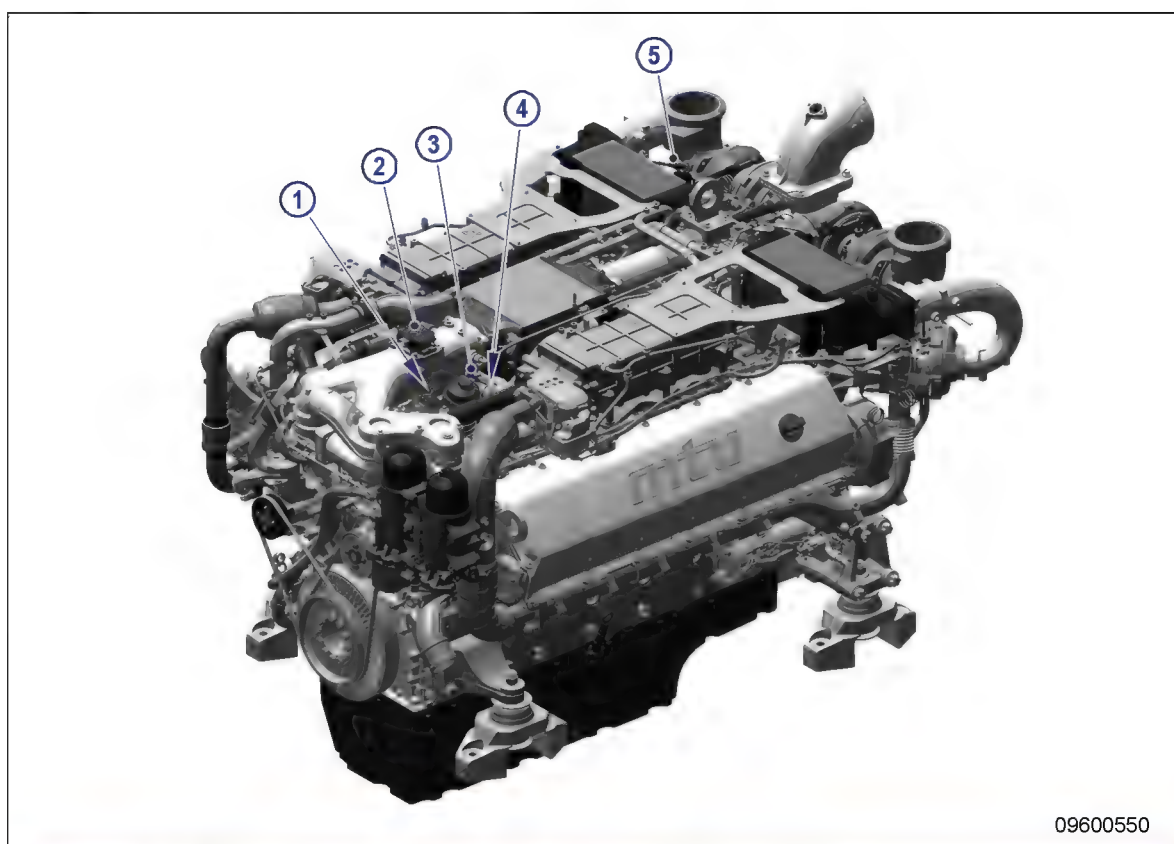
### Engine model designation

Key to the engine model designations 12 V 1600 Rxy

12	Number of cylinders
V	Cylinder arrangement: V engine
1600	Series
R	Application
x	Application segment
y	Design index

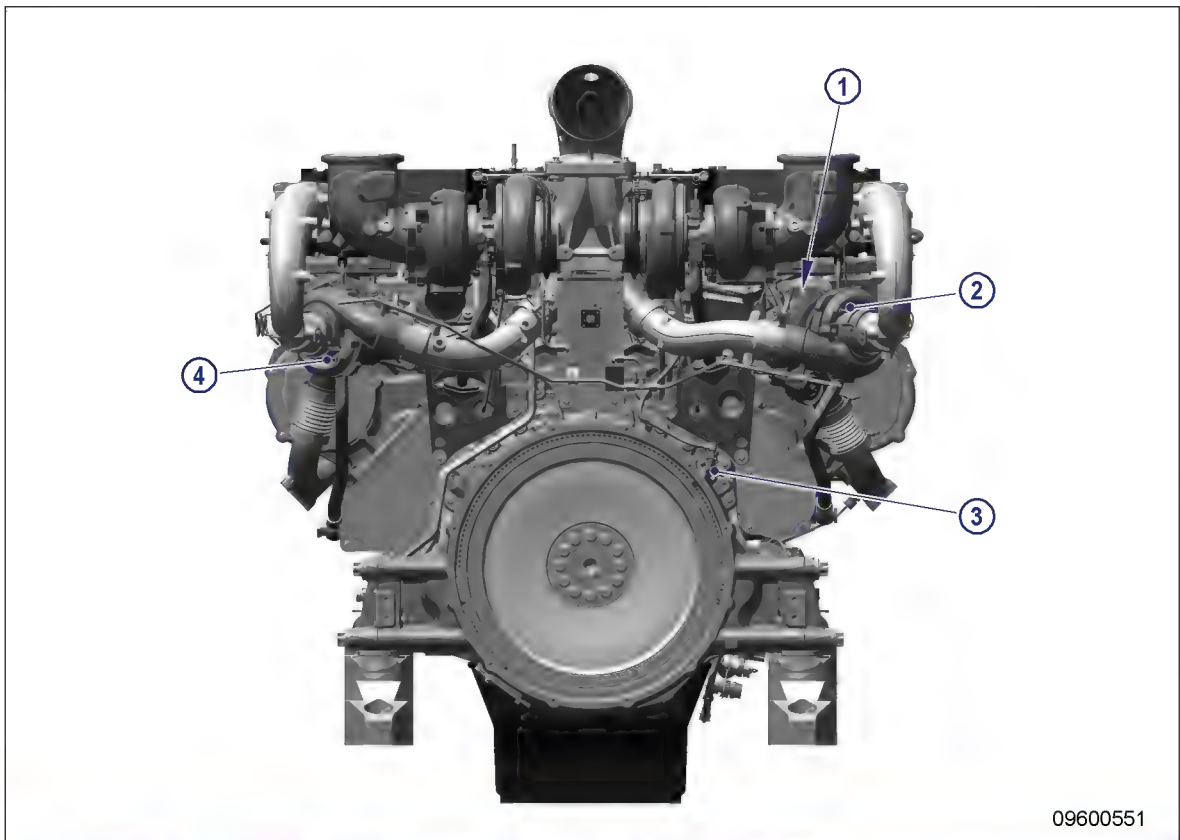
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## 2.3 Sensors and actuators



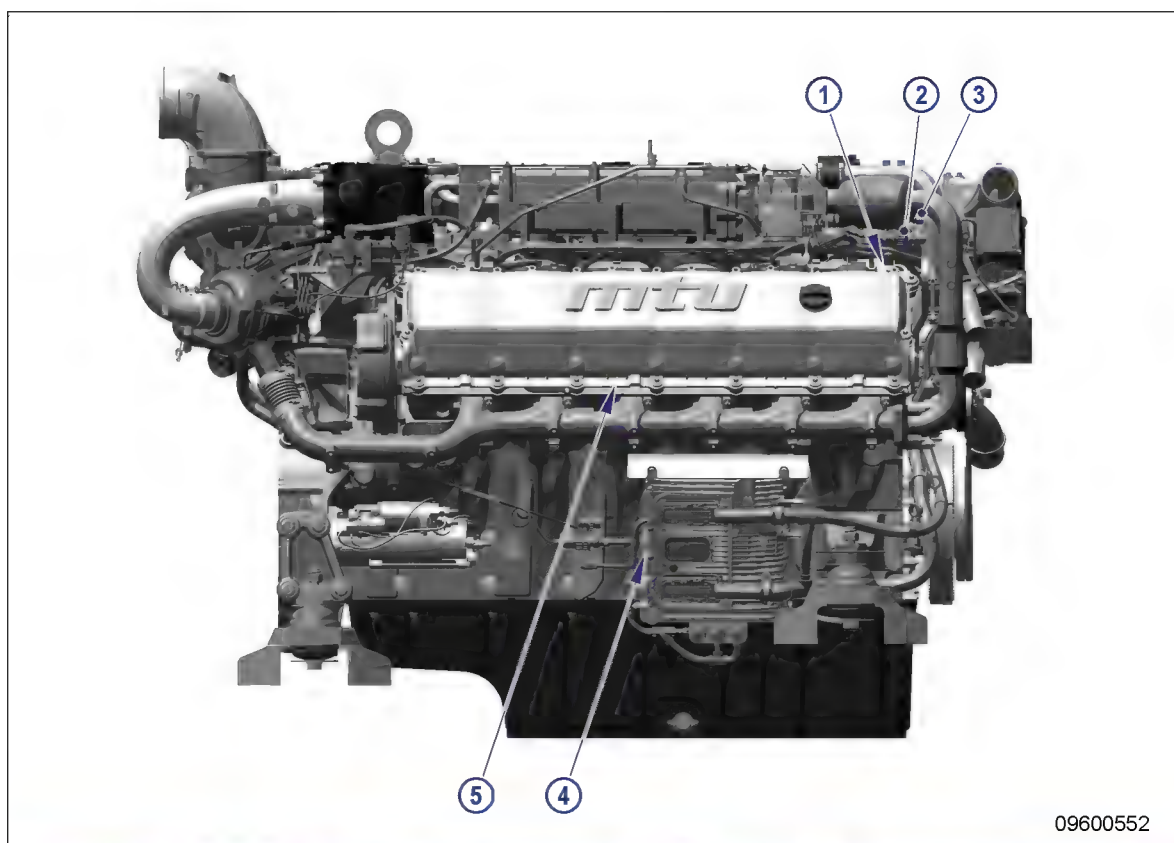
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No.	Description	Monitoring of
1	B5.1	Lube oil pressure after filter
2	B10	Charge-air pressure
3	B9.1	Charge-air temperature before EGR mixing
4	B5.3	Lube oil pressure before filter
5	B89	Lambda



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No.	Description	Monitoring of
1	B1	Camshaft speed
2	B44.2	Turbocharger B speed
3	B13	Crankshaft speed
4	B44.1	Turbocharger A speed



No.	Description	Monitoring of
1	B7	Lube oil temperature
2	B43	Charge-air coolant pressure
3	B26	Charge-air coolant temperature
4	B93	Level and temperature, lube oil
5	B6	Coolant temperature

## 3 Technical Data

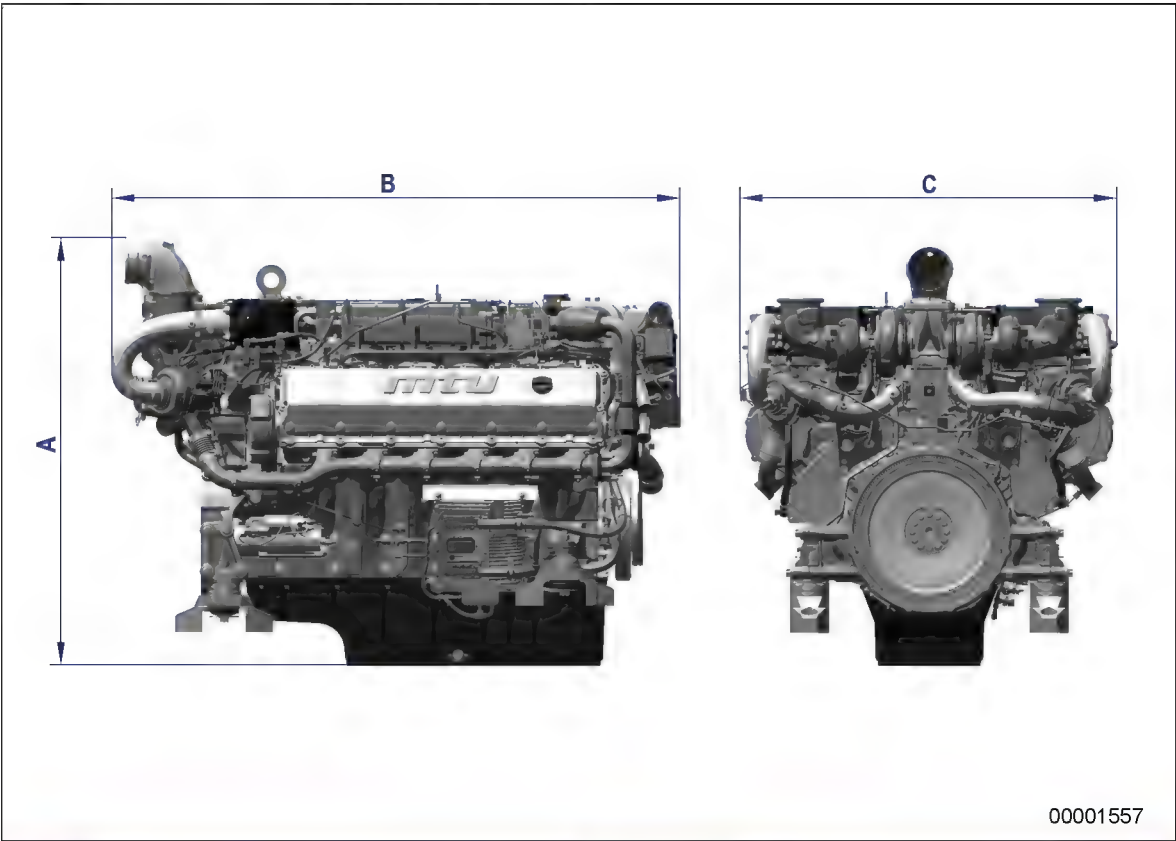
### 3.1 Firing order

12 V	A1-B2-A5-B4-A3-B1-A6-B5-A2-B3-A4-B6
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#### Direction of rotation

Direction of rotation (as viewed on driving end)	c.c.w., not reversible
--	------------------------

### 3.2 Engine – Main dimensions



Item	Dimensions
Height (A)	Approx. 1401 mm
Length (B)	Approx. 1873 mm
Width (C)	Approx. 1263 mm

### 3.3 12V 1600 R50 engine data

Explanation:

- DL Ref. value: Continuous power
- BL Ref. value: Fuel stop power
- A Design value
- G Guaranteed value
- R Guideline value
- L Limit value, up to which the engine can be operated, without change (e.g. of power setting)
- N Not yet defined value
- Not applicable
- X Applicable
- \* Estimated or extrapolated value

#### REFERENCE CONDITIONS

Engine model			12V 1600 R50
Application group			2A
Intake air temperature		°C	25
Charge-air coolant temperature		°C	45
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

#### POWER-RELATED DATA (power ratings are net brake power to ISO 3046)

Number of cylinders			12V
Rated engine speed	A	rpm	1900
Mean piston speed		m/s	9.5
Fuel stop power ISO 3046	A	kW	690
Mean effective pressure (MEP) (fuel stop power ISO 3046)		bar	20.4

#### MODEL RELATED DATA (basic design)

Number of cylinders			12V
Number of cylinders			12
Cylinder arrangement: V angle		Degrees (°)	90
Bore		mm	122
Stroke		mm	150
Cylinder displacement		liters	1.75
Total displacement		liters	21
Compression ratio			17.5
Number of inlet valves per cylinder			2
Number of exhaust valves per cylinder			2

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Number of cylinders			12V
Number of turbochargers			4
Number of intercoolers			3

## CAPACITIES

Number of cylinders			12V
Engine coolant capacity, engine side (without cooling equipment)	R	liters	50*
Engine oil capacity, initial filling (standard oil system)(Option: max. operating inclinations)	R	liters	65
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liters	63

## WEIGHTS / MAIN DIMENSIONS

Number of cylinders			12V
Engine weight, dry (basic engine configuration acc. to scope of delivery specification)	R	kg	2200

## ACOUSTICS

Number of cylinders			12V
Engine surface noise with attenuated intake noise (filter) - DL (free-field sound-pressure level Lp, 1m distance, ISO 6798)	R	dB(A)	101
Engine surface noise with attenuated intake noise filter) - DL (sound power level LW, ISO 6798)	R	dB(A)	119

## 4 Operation

### 4.1 Preparation for startup after a scheduled break in operation

#### Preconditions

- ☒ Engine is stopped and starting disabled.

#### Starting up

Item	Action
Lube oil system	Check engine oil level (→ Page 46).
Coolant circuit	Check engine coolant level (→ Page 49); Check charge-air coolant level (→ Page 56).
Coolant circuit	Preheat engine coolant with coolant preheating unit (if fitted).
Fuel prefilter	Drain fuel prefilter (→ Page 43).
Engine control system	Switch on.

## 4.2 Preparation for startup after extended out-of-service periods (>3 months)

### Preconditions

- ☑ Engine is stopped and starting disabled.
- ☑ MTU Fluids and Lubricants Specifications (A001063/..) are available.

### Startup after long out-of-service periods (>3 months)

Item	Action
Engine	Depreserve (→ MTU Fluids and Lubricants Specifications A001063/..).
Lube oil system	Check engine oil level (→ Page 46).
Fuel system	Vent (→ Page 41).
Coolant circuit	If engine is out of service for more than one year, change engine coolant (→ Page 50). Change charge-air coolant (→ Page 57).
Coolant circuit	Check engine coolant level (→ Page 49); Check charge-air coolant level (→ Page 56).
Coolant circuit	Preheat engine coolant with coolant preheating unit (if fitted).
Engine governor	Check plug-in connections (→ Page 64).
Engine control system	Switch on.

## 4.3 Starting the engine

### Preconditions

- ☒
- ☒ Engine is not connected to load.
- ☒ External start interlock is not active.

#### DANGER



Unguarded rotating and moving engine components.

**Risk of serious injury – danger to life!**

- Before barring or starting the engine, make sure that nobody is in the danger zone.

#### WARNING



Engine noise above 85 dB (A).

**Risk of damage to hearing!**

- Wear ear protectors.

### Starting the engine

Item	Action
Switchgear cabinet, control panel etc. (depending on manufacturer)	<p>Press start button.</p> <ul style="list-style-type: none"><li>• Automatic starting procedure is performed;</li><li>• Tachometer indicates increasing speed.</li><li>• After completion of starting sequence, the engine is running at idle speed.</li></ul>

## 4.4 Operational checks

### DANGER



Unguarded rotating and moving engine components.

**Risk of serious injury – danger to life!**

- Take special care when working on a running engine.

### WARNING



Engine noise above 85 dB (A).

**Risk of damage to hearing!**

- Wear ear protectors.

### Operational checks


Item	Action
Control and display panels	Check readings of operational data (speed, temperature, pressures).
Engine oil	Check engine oil level (→ Page 46).
Engine operation	Check engine visually for leaks and general condition; Check engine for abnormal running noises, exhaust color and vibrations (→ Page 34).
Air filter	Check filter restriction indicator on the air filter (if fitted) (→ Page 45).
Exhaust system	Check exhaust color (→ Page 34).
Engine coolant pump	Check relief bore (→ Page 55).
Charge-air coolant pump	Check relief bore (→ Page 61).

# 4.5 Stopping the engine

## Preconditions

- ☑ Engine is not connected to load.

CAUTION



Stopping the engine when it is running at full load causes extreme stress to the engine.

**Risk of overheating, damage to components!**

- Before stopping the engine, operate it at idle speed until operating temperatures decrease and stable values are indicated.

## Stopping the engine

Item	Action
Temperature indications	Wait until engine temperatures are constant.
Switchgear cabinet, control panel etc. (depending on manufacturer)	<div>Press stop button.<ul style="list-style-type: none"><li>• Automatic stopping procedure is performed.</li><li>• Engine at a standstill.</li></ul></div>

## 4.6 After engine shutdown

### Preconditions

- ☒ MTU Fluids and Lubricants Specifications (A001063/..) are available.

**Note:** If freezing temperatures are to be expected: Coolant pressure sensors installed in vertical position may be damaged if the coolant does not contain antifreeze additive.

### After engine shutdown

Item	Action
Coolant circuit	Drain engine coolant (→ Page 51); Drain charge-air coolant (→ Page 58) if: <ul style="list-style-type: none"><li>• freezing temperatures are expected and the engine is to remain out of service for an extended period, but engine coolant has no antifreeze additive;</li><li>• the engine room is not heated;</li><li>• the coolant is not kept at a suitable temperature;</li><li>• the antifreeze concentration is insufficient for the engine-room temperature;</li><li>• antifreeze concentration is 50 % and engine-room temperature is below -40 °C.</li></ul>
Engine control system	Switch off.
Air intake and exhaust systems	If the engine is to remain out of service for more than 1 week, seal the engine's air and exhaust sides. If the engine is to remain out of service for more than 1 month, carry out preservation (→ MTU Fluids and Lubricants Specifications A001063/..).

## 4.7 Plant – Cleaning

### Preconditions

- ☒ Engine is stopped and starting disabled.
- ☒ Operating voltage is not applied.

### Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Steam jet cleaner	-	1
Cleaner (Hakupur 312)	30390	1

#### WARNING



Compressed air

#### Risk of injury!

- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

#### WARNING



Water jet.

#### Risk of injury and scalding!

- Do not direct water jet at persons.
- Wear protective clothing, gloves, and goggles / safety mask.

#### CAUTION



Excessive reaction time of cleaning agents on components.

#### Damage to component!

- Observe manufacturer's instructions.
- Wear protective clothing, gloves, and goggles / safety mask.

Note: There is a risk of damaging sensors with compressed air.

### Plant – Cleaning

1. Carry out plant cleaning only in areas where an appropriate oil separator is provided (environmental protection).
2. Prior to putting the cleaning unit into operation, read the Operating Instructions of the water/steam jet unit carefully and observe the safety precautions.
3. For external cleaning with high-pressure jet, use a flat-mouth nozzle only.
4. Carry out external cleaning as follows:
  - a) Remove coarse dirt.
  - b) Spray on cleaner sparingly and leave it for 1 to 5 minutes.
  - c) Use the high-pressure jet to remove the loosened dirt.
  - d) During external cleaning of the plant with water/steam-jet units, the pressure of the high-pressure jet (cleaning jet) must not exceed 50 bar. A minimum distance between spray nozzle and plant of 1 m must be observed. The temperature of the cleaning medium must not exceed 80 °C.

# 5 Maintenance

## 5.1 Preface

### MTU maintenance concept

The following applies in the case of engines which are subject to emissions regulations:

Emissions regulations prohibit alteration, removal or addition of any mechanical or electronic component or calibration that could affect the emissions characteristics of the engine. Maintenance, replacement, or repair of emissions-relevant components, e.g. control devices, sensors, cylinder heads and exhaust flaps, can only be performed using MTU approved components or equivalents.

Failure to adhere to the maintenance instructions could result in violation of legal requirements.

The MTU Maintenance Schedules ensure the reliability and performance of MTU engines and must be complied with over the entire life cycle of the engine. In the case of engines which are not subject to any emissions regulations, the maintenance intervals cited are to be regarded as guideline values.

This maintenance schedule includes preventive and on-condition maintenance.

The maintenance schedule is based on the load profile / load factor specified below. Special operating conditions and technical requirements may require additional maintenance work and/or modification of the maintenance intervals. The intervals according to which the maintenance tasks have to be carried out are specified as operating hours and time limits. The limit which occurs first is applicable. In order to be authorized to carry out the individual maintenance jobs, maintenance personnel must have achieved a level of training and qualification appropriate to the complexity of the task in hand. The various Qualification Levels QL1 to QL4 reflect the levels of training offered in MTU courses and the contents of the tool kits required:

- QL1: Operational monitoring and maintenance which can be carried out during a break in operation without disassembling the engine.
- QL2: Component replacement (corrective only).
- QL3: Maintenance work which requires partial disassembly of the engine.
- QL4: Maintenance work which requires complete disassembly of the engine.

The maintenance schedule matrix finishes after 18 years at the latest. Following this, maintenance work is to be continued at the intervals indicated.

The numbers specified in the measures list serve as reference to the required parts scope.

### Notes on maintenance

Specifications for fluids and lubricants, guideline values for their maintenance and change intervals and lists of recommended fluids and lubricants are contained in the MTU Fluids and Lubricants Specifications A001063 and in the fluids and lubricants specifications produced by the component manufacturers. They are therefore not included in the maintenance schedule (exception: deviations from the Fluids and Lubricants Specifications). All fluids and lubricants used must meet MTU specifications and be approved by the relevant component manufacturer.

Amongst other items, the operator/customer must carry out the following additional maintenance work:

- Protect components made of rubber or synthetic material from oil. Never treat them with organic detergents. Wipe with a dry cloth only.
- Fuel prefilter:  
The maintenance interval depends on how dirty the fuel is. The paper inserts in fuel prefilters must be changed every two years at the latest (Task 9998).
- Battery:  
Battery maintenance depends on the level of use and the ambient conditions. The specifications of the battery manufacturer apply.

The relevant manufacturer's instructions apply with respect to the maintenance of any components which do not appear in this maintenance schedule.

This Maintenance Schedule may include components which are not included in the MTU supply scope; these may be disregarded.

### Out-of-service periods

If the engine is to remain out of service for more than 1 month, carry out engine preservation procedures in accordance with the Fluids and Lubricants Specifications, MTU Publication No. A001063.

### Application group

2A	Continuous operation, unrestricted
----	------------------------------------

### Load profile

Power	100%	60%	50%	30%	<15%	
Associated runtime	0,5%	4,5%	10%	20%	65%	

## 5.2 Maintenance task reference table [QL1]

The maintenance tasks and intervals for this product are defined in the Maintenance Schedule. The Maintenance Schedule is a stand-alone publication.

The task numbers in this table provide reference to the maintenance tasks specified in the Maintenance Schedule.

Task	Maintenance tasks	
W0500	Check engine oil level	(→ Page 46)
W0501	Visually inspect engine for leaks and general condition	(→ Page 27)
W0502	Check intercooler drain (if fitted)	(→ Page 27)
W0503	Check air filter service indicator	(→ Page 27)
W0506	Check engine for abnormal running noises, exhaust color and vibrations	(→ Page 27)
W0507	Drain water and contaminants from fuel prefilter (if fitted)	(→ Page 27)
W0508	Check reading on differential pressure gauge of fuel prefilter (if fitted)	–
W1001	Replace fuel filter or fuel filter element	(→ Page 42)
W1008	Replace engine oil filter at each oil change or when the time limit (years) is reached, at the latest	(→ Page 48)
W1013	Replace drive belt	
W1207	Check valve clearance, adjust if necessary.ATTENTION! First adjustment after 1,000 operating hours!	(→ Page 37)
W1586	Replace diesel oxidation catalyst	–
W1659	Clean particle catalyst, replace if necessary	–

Table 1: Maintenance task reference table [QL1]

# 6 Troubleshooting

## 6.1 Troubleshooting

### Engine does not turn when starter is actuated

Component	Cause	Action
Battery	Low or faulty	Charge or replace (see manufacturer's documentation).
	Cable connections faulty	Check if cable connections are properly secured (see manufacturer's documentation).
Starter	Engine cabling or starter faulty	Check cable connections for secure seating ; Contact Service.
Engine wiring	Faulty	Check (→ Page 62).
Engine Control Unit	Plug-in connections possibly loose	Check plug-in connections (→ Page 64).
Engine	Running gear blocked (engine cannot be barred manually)	Contact Service.

Table 2: Engine does not turn when starter is actuated

### Engine turns but does not fire

Component	Cause	Action
Starter	Poor rotation by starter: Battery low or faulty	Charge or replace battery (see manufacturer's documentation).
Engine wiring	Faulty	Check (→ Page 64).
Fuel system	Air in fuel system, if fault occurs after filling the system	Vent fuel system (→ Page 41).
Engine Control Unit	Faulty	Contact Service.

Table 3: Engine turns but does not fire

### Engine fires unevenly

Component	Cause	Action
Fuel injection equipment	Injector faulty	Contact Service.
Engine wiring	Faulty	Check (→ Page 62).
Fuel system	Air in fuel system, if fault occurs after filling the system	Vent fuel system (→ Page 41).
Engine Control Unit	Faulty	Contact Service.

Table 4: Engine fires unevenly

## Engine does not reach rated speed

Component	Cause	Action
Fuel supply	Fuel prefilter (if fitted) clogged	Clean filter element (see manufacturer's documentation).
	Fuel filter clogged	Replace (→ Page 42).
Air supply	Air filter clogged	Replace air filter (→ Page 44).
Fuel injection equipment	Injector faulty	Contact Service.
Engine wiring	Faulty	Check (→ Page 62).
Engine	Overloaded	Contact Service.

Table 5: Engine does not reach rated speed

## Engine speed not steady

Component	Cause	Action
Fuel injection equipment	Injector faulty	Contact Service.
Speed sensor	Faulty	Contact Service.
Fuel system	Air in fuel system, if fault occurs after filling the system	Vent fuel system (→ Page 41).
Engine Control Unit	Faulty	Contact Service.

Table 6: Engine speed not steady

## Charge-air temperature too high

Component	Cause	Action
Engine coolant	Engine coolant treatment incorrect	Check (MTU test kit).
Intercooler	Contaminated	Contact Service.
Engine room	Air-intake temperature too high	Check fan; check air inlet/outlet ducts.

Table 7: Charge-air temperature too high

## Charge-air pressure too low

Component	Cause	Action
Air supply	Air filter clogged	Replace air filter (→ Page 44).
Intercooler	Contaminated	Contact Service.
Exhaust turbocharger	Faulty	Contact Service.

Table 8: Charge-air pressure too low

## Coolant leaks at intercooler

Component	Cause	Action
Intercooler	Leaking, major coolant discharge	Contact Service.

Table 9: Coolant leaks at intercooler

## Black exhaust gas

Component	Cause	Action
Air supply	Air filter clogged	Replace air filter (→ Page 44).
Fuel injection equipment	Injector faulty	Contact Service.
Engine	Overloaded	Contact Service.

Table 10: Black exhaust gas

## Blue exhaust gas

Component	Cause	Action
Engine oil	Too much oil in engine	Drain engine oil (→ Page 47).
	Oil mist fine separator of crankcase breather clogged	Contact Service.
Exhaust turbocharger	Faulty	Contact Service.
Cylinder head		
Piston rings		
Cylinder liner		

Table 11: Blue exhaust gas

## White exhaust gas

Component	Cause	Action
Engine	Not at operating temperature	Run engine to reach operating temperature.
Fuel system	Water in fuel	Check fuel system at fuel prefilter Drain fuel prefilter (→ Page 43).
Intercooler	Leaking	Contact Service.

Table 12: White exhaust gas

# 7 Task Description

## 7.1 Valve Drive

### 7.1.1 Valve clearance – Check and adjustment

#### Preconditions

- ☑ Engine is stopped and starting disabled.
- ☑ Engine coolant temperature is max. 40 °C.
- ☑ Valves are closed.

#### Special tools, Material, Spare parts

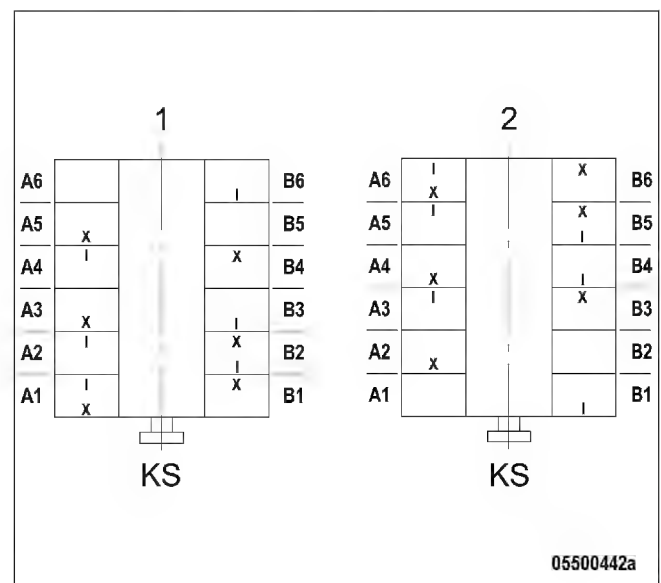
Designation / Use	Part No.	Qty.
Feeler gauge	Y20010128	1
Torque wrench, 20-100 Nm	F30026582	1
Box wrench, 14 mm	F30028346	1
Allen key, 5 mm	F30002815	1
Barring device	F6790714	1

#### Preparatory steps

1. Remove cylinder head cover (→ Page 39).
2. Remove cover on the bottom of flywheel housing, A side.
3. Install barring device at opening.
4. Rotate crankshaft with barring device in engine direction of rotation until "OT-A1" mark and pointer are aligned.

#### Diagram for 12V engines (two crankshaft positions)

- 1 Cylinder A1 is in firing TDC
- 2 Cylinder A1 is in overlap TDC
- I Inlet valve
- X Exhaust valve

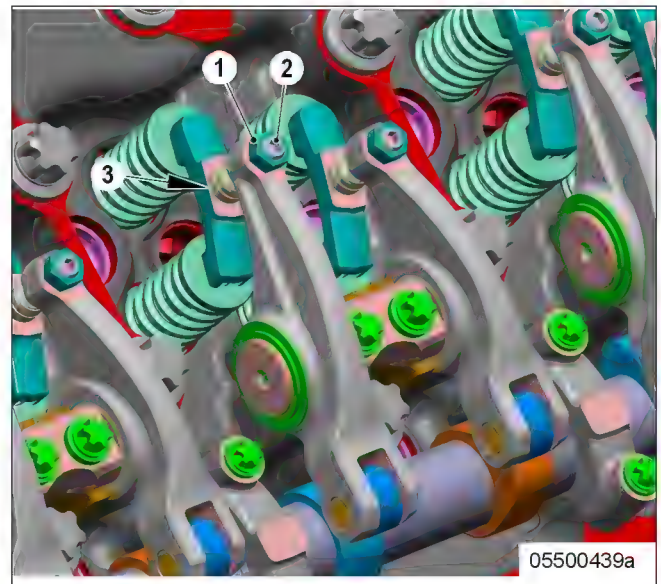


## Checking valve clearance at two crankshaft positions

1. Check TDC position of piston in cylinder A1:
  - If the rocker arms are unloaded on cylinder A1, the piston is in firing TDC.
  - If the rocker arms are under load on cylinder A1, the piston is in overlap TDC.
2. Check valve clearance with cold engine:
  - Inlet = 0.3 +/- 0.05 mm;
  - Exhaust = 0.6 +/- 0.05 mm.
3. Check all valve clearances in two crankshaft positions (firing TDC and overlap TDC of cylinder A1) as per diagram.
4. Use feeler gauge to determine the distance between valve bridge and rocker arm.
5. If the deviation from the reference value exceeds 0.1 mm, adjust valve clearance.

## Adjusting valve clearance

1. Loosen locknut (1) and unscrew adjusting screw (2) by a few threads.
2. Insert feeler gauge between valve bridge and rocker arm (3).
3. Readjust adjusting screw (2) so that the feeler gauge just passes through the gap.



4. Tighten locknut (1) with torque wrench to specified torque, holding adjusting screw (2) firm with Allen screw.

Nome	Size	Type	Lubricant	Value/Standard
Nut	M10 x 1	Tightening torque		43 Nm +4 Nm

5. Check if the feeler gauge just passes through between valve bridge and rocker arm (3).

Result: If not, adjust valve clearance.

## Final steps

1. Remove barring device.
2. Install cover.
3. Install cylinder head cover (→ Page 39).

### 7.1.2 Cylinder head cover – Removal and installation

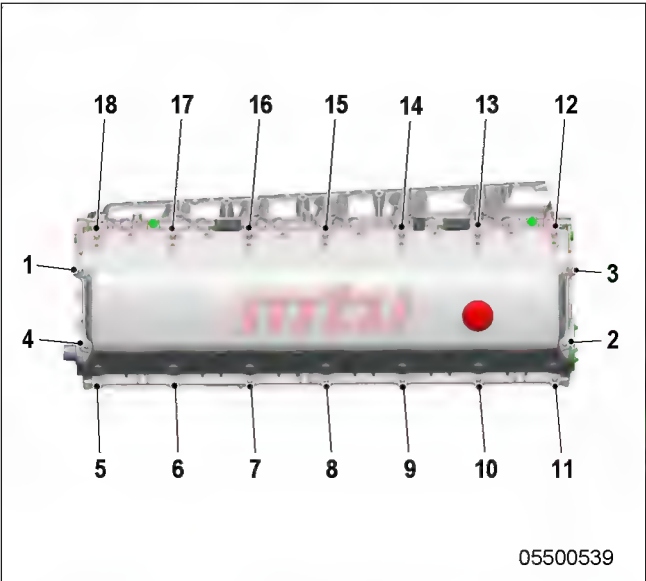
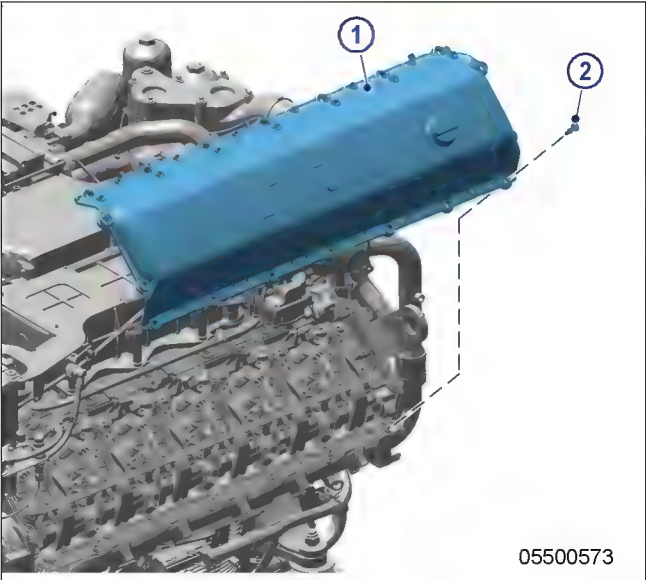
#### Preconditions

- ☑ Engine is stopped and starting disabled.

#### Cylinder head cover – Removal and installation

Note: Cover the engine beneath the cylinder head with cloths to collect emerging oil.

1. Remove screws (2).
2. Remove cylinder head cover (1).
3. Clean mating faces.
4. Check condition of profile gasket and replace if required.



5. Position cylinder head cover and screws at positions 1 to 4 and tighten with torque wrench to the prescribed initial tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw with twin collar	M8	Preload torque		10 Nm

6. Tighten screws at positions 1 to 18 to specified tightening torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw with twin collar	M8	Tightening torque		20 Nm $\pm$ 2 Nm
Consecutive tightening sequence starting at position 1:		1 to 18		

## 7.2 Fuel System

### 7.2.1 Fuel system – Venting

#### Preconditions

- ☑ Engine is stopped and starting disabled.

#### Special tools, Material, Spare parts

Designation / Use	Part No.	Qty
Torque wrench, 4-20 Nm	F30044239	1
Ratchet	F30027340	1

#### WARNING



Fuels are combustible.

#### Risk of fire and explosion!

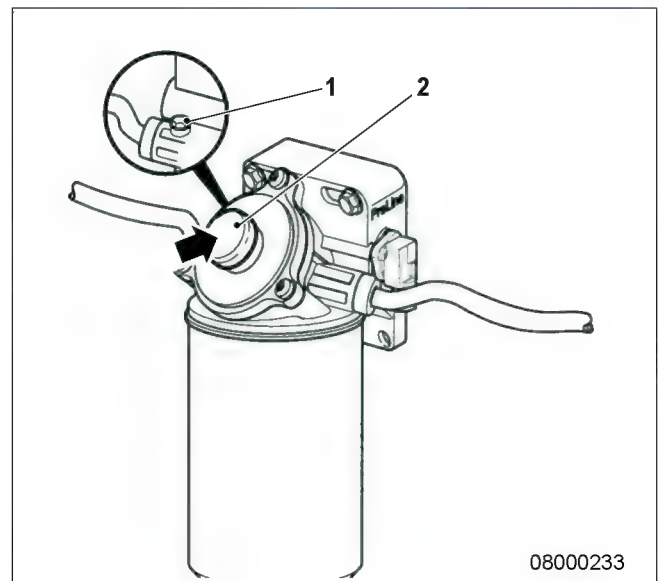
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

#### Venting fuel system

1. Open vent plug (1).

Note: Catch emerging fuel with a suitable cloth.

2. Operate the pump with the handle (2) until bubble-free fuel emerges from the vent plug (1).



3. Close vent plug (1) and tighten with torque wrench to the specified tightening torque.

Item	Size	Type	Lubricant	Value/Standard
Threaded vent plug	12	Tightening torque		6.5 Nm $\pm$ 1.3 Nm

## 7.3 Fuel Filter

### 7.3.1 Fuel filter – Replacement

#### Preconditions

- ☑ Engine is stopped and starting disabled.

#### Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 4-20 Nm	F30044239	1
Torque wrench, 10-60 Nm	F30510423	1
Ratchet adapter	F30027340	1
Socket, 32 mm	F30006120	1
Engine oil		
Fuel filter element	(→ Spare Parts Catalog)	2

#### WARNING



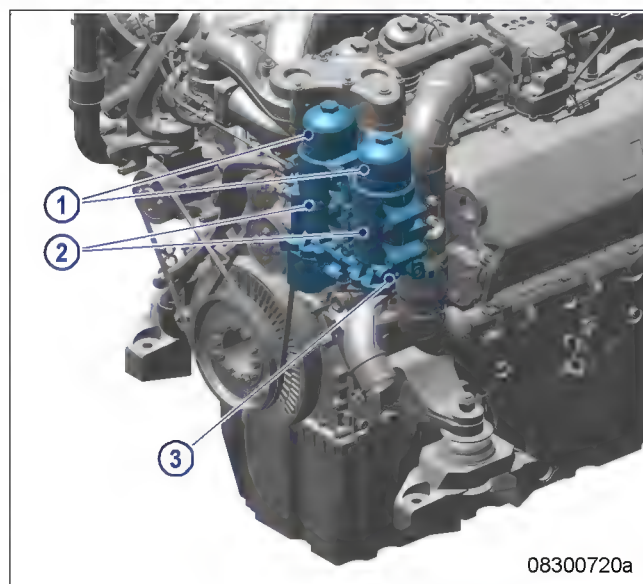
Fuels are combustible.

#### Risk of fire and explosion!

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

#### Fuel filter – Replacement

1. Provide a suitable container in which to collect the fuel.
  2. Unscrew drain screw (3).
- Note: Do not completely remove drain screw.
3. Loosen screw cap (1) on fuel filter and unscrew it approx. 3 to 4 turns.
  4. Wait 10 minutes, until fuel emerges from filter housing (2).
  5. Remove screw cap (1) with fuel filter element and remove element by pressing it to the side at the lower edge.
  6. Check condition of the sealing ring on the screw cap (1).
  7. Replace damaged sealing ring.
  8. Coat sealing ring with engine oil.
  9. Insert new oil filter element in screw cap (1) and press in until it locks in place.
10. Screw on the cap (1) with oil filter element and tighten to the specified torque with a torque wrench.



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Name	Size	Type	Lubricant	Value/Standard
Cover		Tightening torque	(Engine oil)	40 Nm ±5 Nm

11. Screw in drain plug (3) and tighten with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Drain plug	10	Tightening torque	(Engine oil)	6.5 Nm ±1.3 Nm

12. Vent fuel system (→ Page 41).

## 7.3.2 Fuel prefilter – Drain condensate

### Preconditions

- ☑ Engine is stopped and starting disabled.

#### WARNING



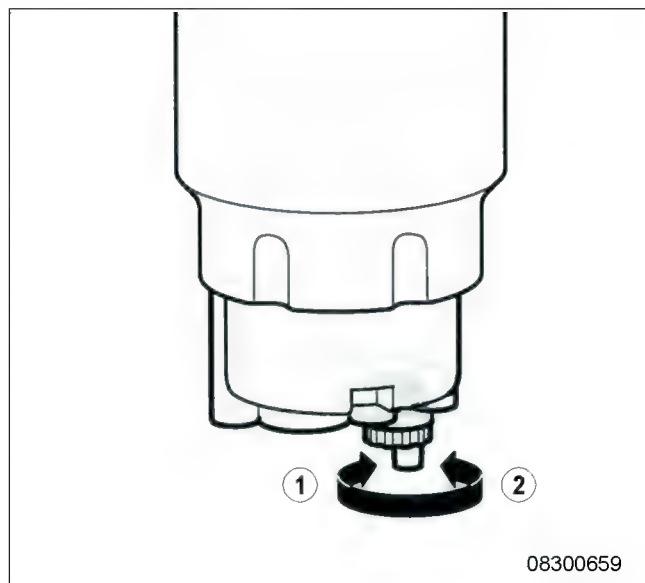
Fuels are combustible.

#### Risk of fire and explosion!

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

### Draining condensate from fuel prefilter

1. Provide a suitable container to collect the water.
2. Open drain screw (1).
3. Allow water to drain off.
4. Screw in and close drain screw (2).



## 7.4 Air Filter

### 7.4.1 Air filter – Replacement

#### **Preconditions**

- ☒ Engine is stopped and starting disabled.

**For air filter replacement, carry out operations as specified by the manufacturer – filter is plant/vehicle manufacturer's supply.**

## 7.5 Air Intake

### 7.5.1 Service indicator – Signal ring position check

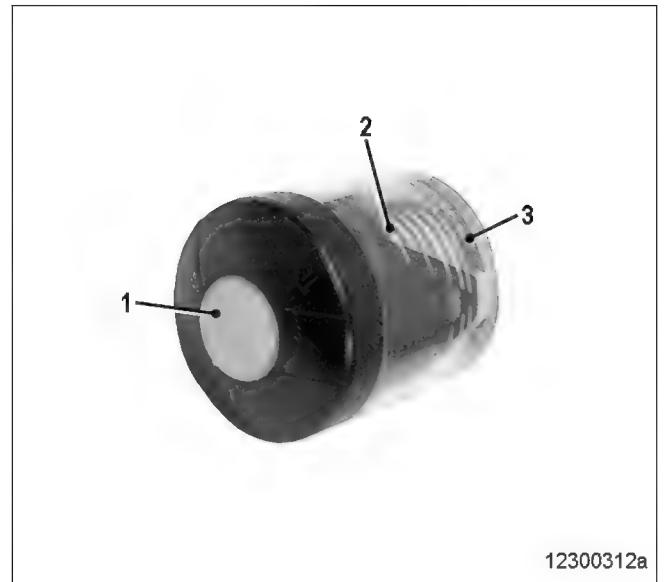
#### Preconditions

- ☑ Engine is stopped and starting disabled.

#### Checking signal ring position

1. Replace air filter, if the signal ring (2) is completely visible in the red area of the service indicator control window (3) (→ Page 44).
2. After installation of new filter, press reset button (1).

Result: Signal ring returns to initial position.



## 7.6 Lube Oil System, Lube Oil Circuit

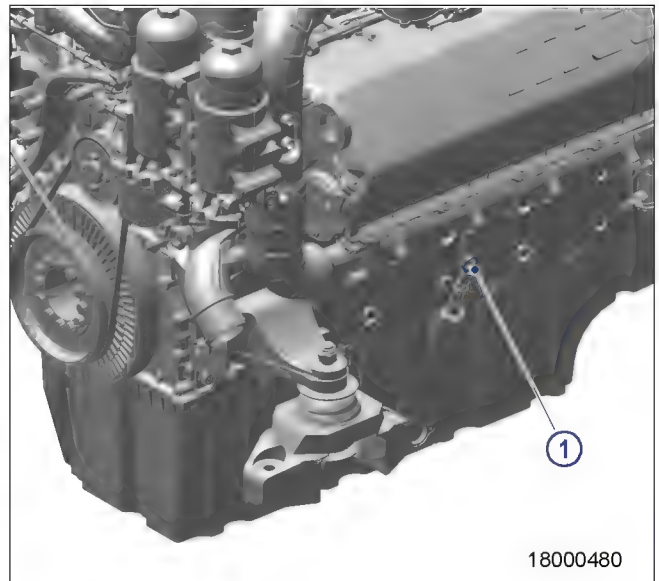
### 7.6.1 Engine oil level – Check

#### Preconditions

- ☑ Engine is stopped and starting disabled.

#### Checking oil level prior to engine start

1. Remove oil dipstick (1) from guide tube and wipe it.
2. Insert oil dipstick (1) into guide tube up to the stop, withdraw after approx. 10 seconds and check oil level.
3. Oil level must be between "min." and "max." marks.
4. If necessary, top up to "max." mark (→ Page 47).
5. Insert oil dipstick (1) in guide tube up to the stop.



#### Checking oil level after the engine is stopped

1. 5 minutes after stopping the engine, remove oil dipstick (1) from the guide tube and wipe it.
2. Insert oil dipstick (1) into guide tube up to the stop, withdraw after approx. 10 seconds and check oil level.
3. Oil level must be between "min." and "max." marks.
4. If necessary, top up to "max." mark (→ Page 47).
5. Insert oil dipstick (1) in guide tube up to the stop.

## 7.6.2 Engine oil – Change

### Preconditions

- ☑ Engine is stopped and starting disabled.
- ☑ Engine is at operating temperature.
- ☑ MTU Fluids and Lubricants Specifications (A001063/..) are available.

### Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine oil		

#### WARNING

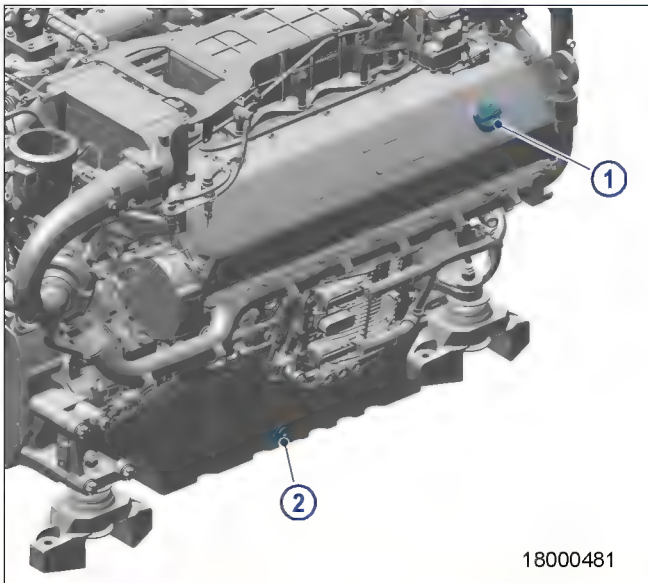


Hot oil.  
Oil can contain combustion residues which are harmful to health.  
**Risk of injury and poisoning!**

- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

### Draining oil via drain plug on oil pan

1. Provide a suitable container to collect the oil.
2. Remove drain plug (2) and drain oil.



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3. Insert drain plug (2) and use torque wrench to tighten to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Drain plug		Tightening torque	(Engine oil)	100 Nm

4. Replace engine oil filter (→ Page 48).

### Filling with new oil

1. Open cap (1) on cylinder head cover.
2. Fill with oil, oil filling capacity (→ Product Summary - Technical Data).
3. Close cap (1) on cylinder head cover.
4. Check engine oil level (→ Page 46).

## 7.7 Oil Filtration / Cooling

### 7.7.1 Engine oil filter – Replacement

#### Preconditions

- ☑ Engine is stopped and starting disabled.

#### Special tools, Material, Spare parts

Designation / Use	Part No.	Qty
Torque wrench, 10-60 Nm	F30510423	1
Ratchet adapter	F30027340	1
Socket, 32 mm	F30006120	1
Engine oil		
Oil filter element	(→ Spare Parts Catalog)	

#### WARNING



Hot oil.

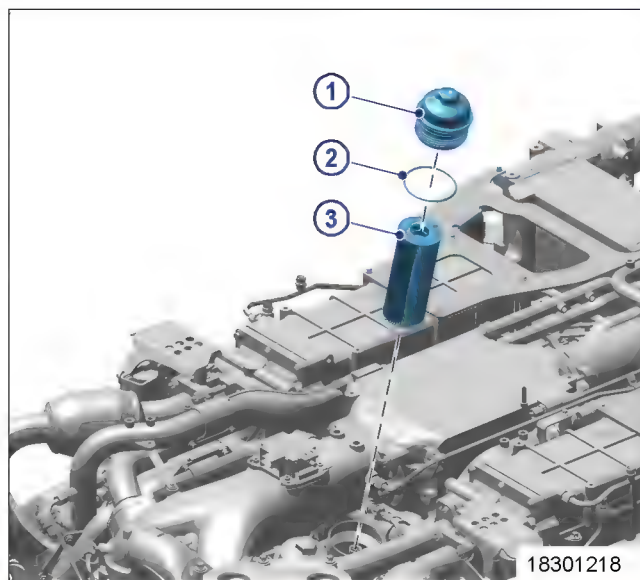
Oil can contain combustion residues which are harmful to health.

#### Risk of injury and poisoning!

- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

#### Engine oil filter – Replacement

1. Unscrew the oil filter covers (1) approx. 3 to 4 revolutions.
2. Wait 10 minutes until the oil has drained from the filter housings.
3. Remove cover (1) with oil filter element (3) and remove oil filter element (3) by pressing on the bottom edge from the side.
4. Check condition of sealing ring (2) on cover.
5. Replace sealing ring (2) if damaged.
6. Coat sealing ring (2) with oil.
7. Insert new oil filter element (3) in cover (1) and press in until it locks in place.



8. Screw on cover (1) with oil filter element (3) and tighten to the specified torque with a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Cover		Tightening torque	(Engine oil)	35 Nm ±3.5 Nm

9. Replace other engine oil filters in the same way.
10. Check oil level (→ Page 46)

## 7.8 Coolant Circuit, General, High-Temperature Circuit

### 7.8.1 Engine coolant – Level check

#### Preconditions

- ☑ Engine is stopped and starting disabled.
- ☑ MTU Fluids and Lubricants Specifications (A001063/..) are available.

#### WARNING



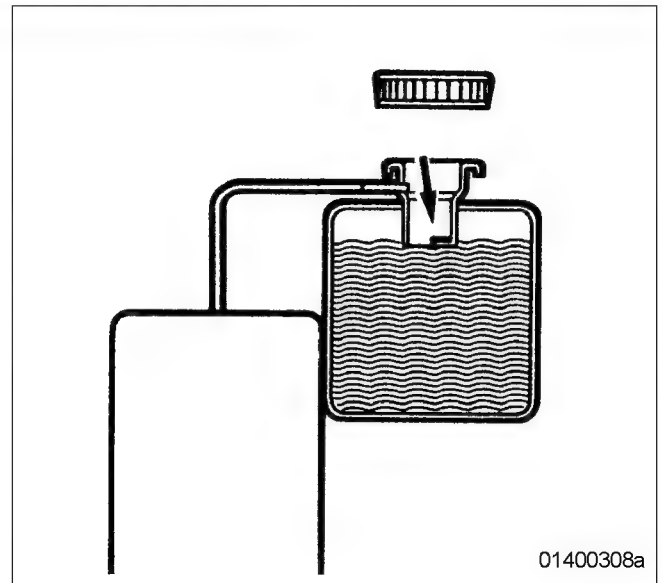
Coolant is hot and under pressure.

#### Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

#### Coolant-level check at filler neck:

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Check coolant level (coolant must be visible at the lower edge of the cast-in eye or at the marking plate).
4. Top up with treated coolant as necessary (→ Page 53).
5. Check breather valve (visual inspection) and clean if necessary.
6. Place breather valve on filler neck and close.



#### Coolant-level check by means of level sensor:

1. Switch on engine control system and check readings on the display.
2. Top up with treated coolant as necessary (→ Page 53).

7.8.2 Engine coolant – Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine coolant		

Changing engine coolant

- 1. Drain engine coolant (→ Page 51).
- 2. Fill with engine coolant (→ Page 53).

### 7.8.3 Engine coolant – Draining

#### Preconditions

- ☑ Engine is stopped and starting disabled.

#### Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine coolant		
Sealing ring	(→ Spare Parts Catalog)	

#### WARNING



Coolant is hot and under pressure.

#### Risk of injury and scalding!

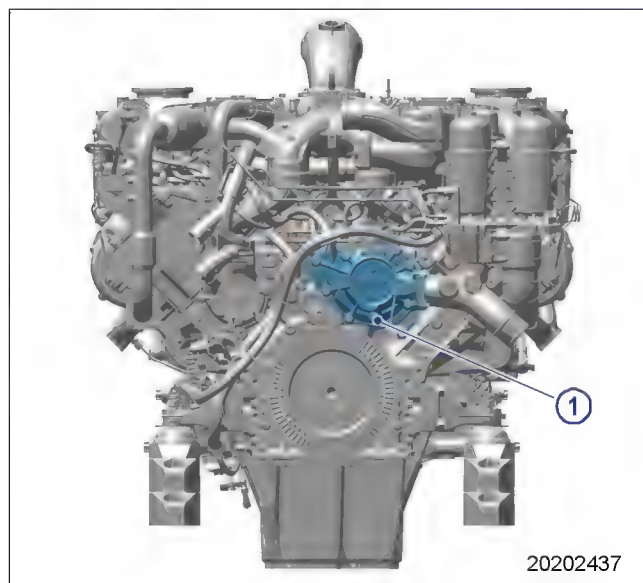
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

#### Preparatory steps

1. Provide an appropriate container to drain the coolant into.
2. Switch off preheater, if installed.

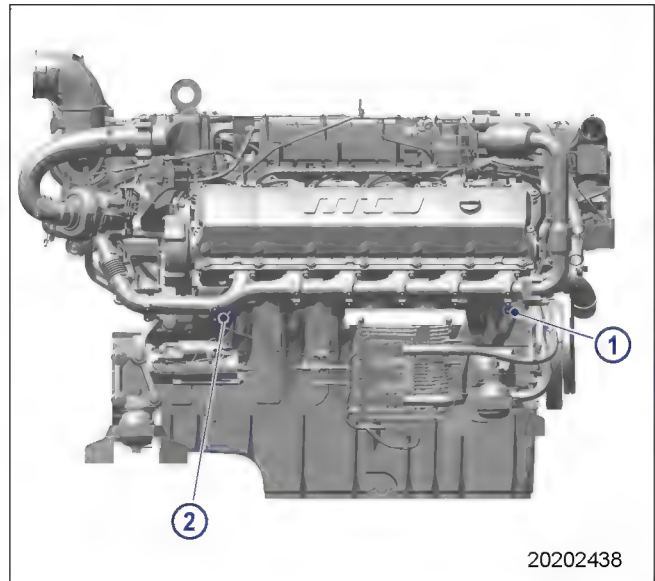
#### Engine coolant – Draining

1. Turn breather valve of filler neck on coolant expansion tank counterclockwise to first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Draw off precipitated corrosion inhibitor oil from the expansion tank through filler neck.
4. Open drain screw and drain off coolant at engine coolant pump (1).

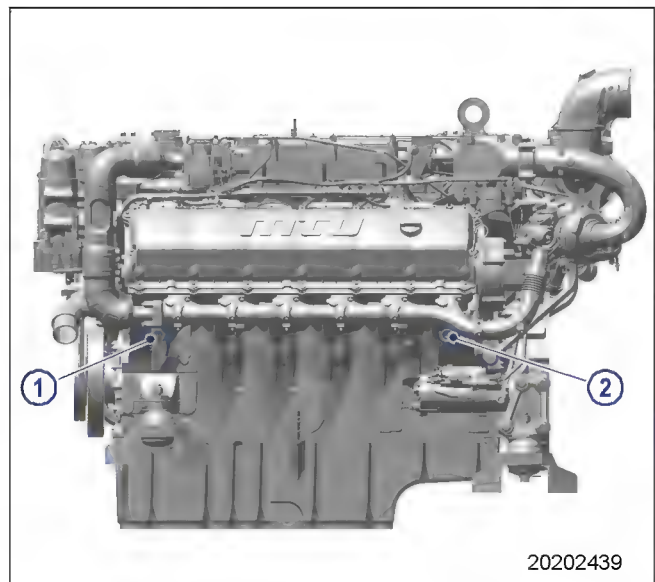


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5. Open drain screws and drain coolant at crankcase, right side (1,2).



6. Open drain screws and drain coolant at crankcase, left side (1,2).
7. Install drain screw with new sealing ring.
8. Place breather valve on filler neck and close.



## 7.8.4 Engine coolant – Filling

### Preconditions

- ☑ Engine is stopped and starting disabled.
- ☑ MTU Fluids and Lubricants Specifications (A001063/..) are available.

### Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine coolant		

#### WARNING



Coolant is hot and under pressure.

#### Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

#### WARNING



Engine noise above 85 dB (A).

#### Risk of damage to hearing!

- Wear ear protectors.

#### CAUTION



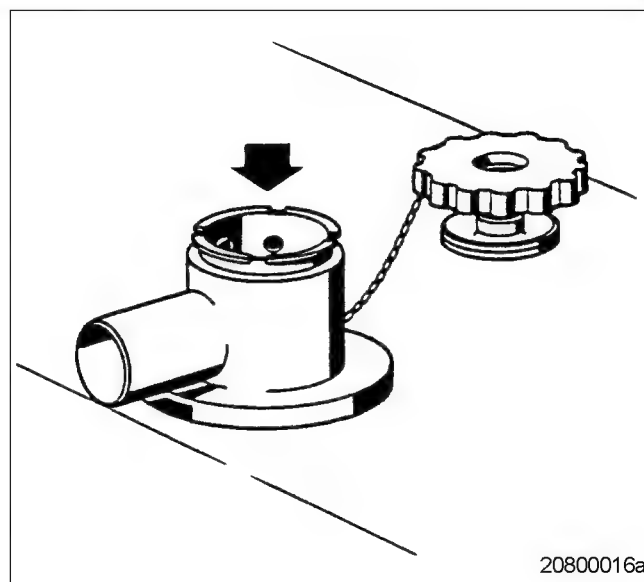
Cold coolant in hot engine can cause thermal stress.

#### Formation of cracks in components!

- Fill / top up coolant only into cold engine.

### Preparatory steps

1. Turn breather valve of filler neck on coolant expansion tank counterclockwise to first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.



### Engine coolant – Filling

1. Fill coolant through filler neck on expansion tank or through filling line until coolant level reaches lower edge of cast-in eye or marking plate.
2. Check proper condition of breather valve, clean sealing faces if required.
3. Fit breather valve and close it.

### **Final steps**

1. Start the engine and operate it at idle speed for some minutes.
2. Check coolant level (→ Page 49), top up if required.

### 7.8.5 Engine coolant pump – Relief bore check

#### DANGER



Unguarded rotating and moving engine components.  
**Risk of serious injury – danger to life!**  
• Take special care when working on a running engine.

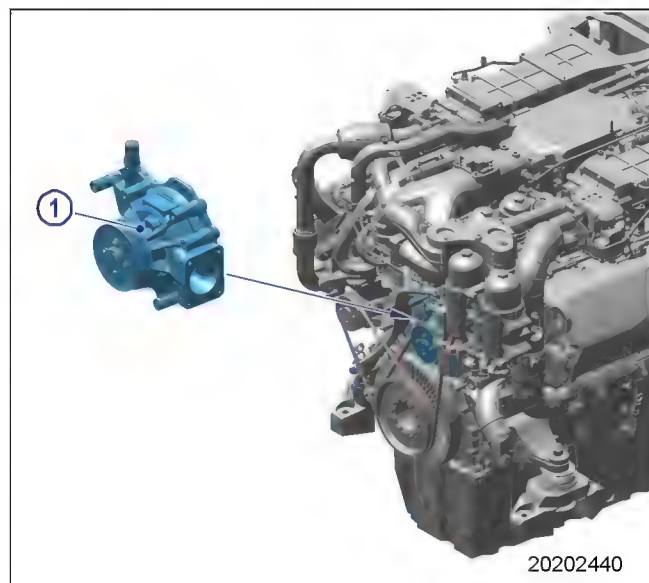
#### WARNING



Engine noise above 85 dB (A).  
**Risk of damage to hearing!**  
• Wear ear protectors.

#### Engine coolant pump – Relief bore check

1. Check relief bore (1) for coolant discharge.
  - Permissible coolant discharge quantity:  
Up to 0.1 ml per hour respectively 100 ml per 1,000 operating hours.
2. Stop engine (→ Page 28) and disable engine start.
3. If discharge exceeds the specified limits, contact Service.



## 7.9 Low-Temperature Circuit

### 7.9.1 Charge-air coolant level – Check

#### Preconditions

- ☑ Engine is stopped and starting disabled.
- ☑ MTU Fluids and Lubricants Specifications (A001063/..) are available.

#### WARNING



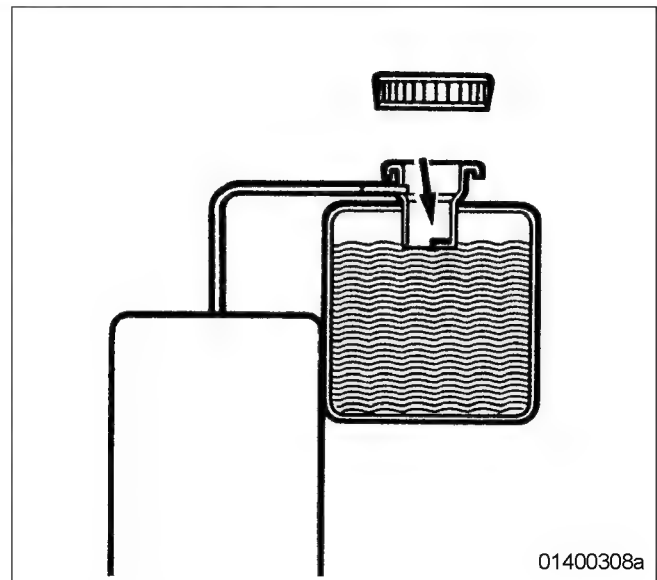
Coolant is hot and under pressure.

#### Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

#### Checking charge-air coolant level at filler neck:

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Check coolant level (coolant must be visible at marking plate).
4. Top up coolant if necessary (→ Page 59).
5. Check proper condition of breather valve, clean sealing faces if required.
6. Fit breather valve and close it.



#### Checking charge-air coolant level by means of level sensor:

1. Switch on engine control system and check display (coolant level is automatically monitored by engine control system).
2. Top up coolant if necessary (→ Page 59).

7.9.2 Charge-air coolant – Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Charge-air coolant		

Charge-air coolant – Change

- 1. Drain charge-air coolant (→ Page 58).
- 2. Fill with charge-air coolant (→ Page 59).

## 7.9.3 Charge-air coolant – Draining

### Preconditions

- ☑ Engine is stopped and starting disabled.

### Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	

#### WARNING



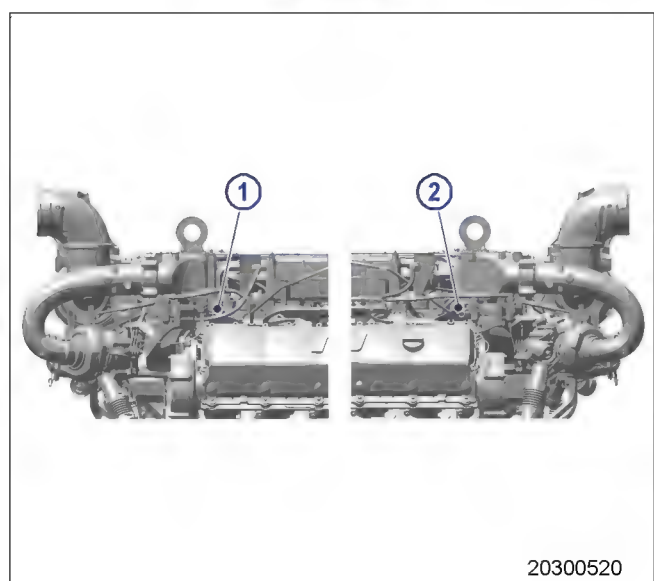
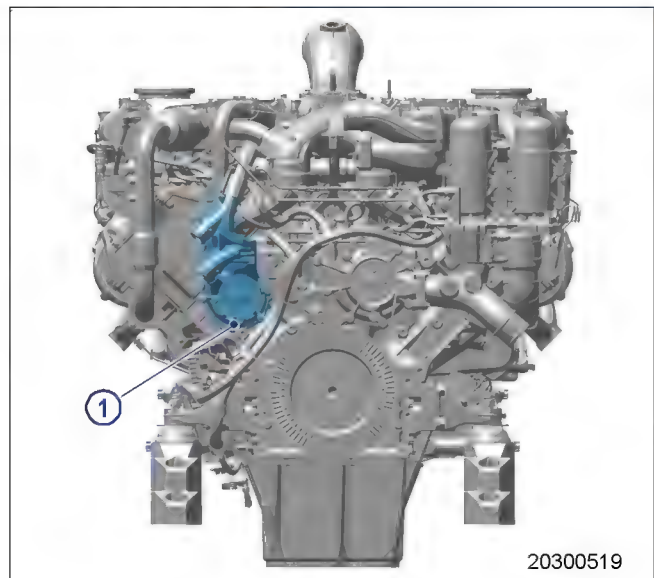
Coolant is hot and under pressure.

#### Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

### Charge-air coolant – Draining

1. Provide an appropriate container to drain the coolant into.
2. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
3. Continue to turn breather valve counterclockwise and remove.
4. Draw off precipitated corrosion inhibitor oil from the expansion tank through filler neck.
5. Open drain screw and drain off coolant at the charge-air coolant pump (1).
6. Open drain plugs and drain coolant on the intercooler, right (1) and left side (2).
7. Screw in drain plugs with new sealing rings.
8. Place breather valve on filler neck and close.



## 7.9.4 Charge-air coolant – Filling

### Preconditions

- ☑ Engine is stopped and starting disabled.
- ☑ MTU Fluids and Lubricants Specifications (A001063/..) are available.

### Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Charge-air coolant		
Sealing ring		(→ Spare Parts Catalog)

#### WARNING



Coolant is hot and under pressure.

#### Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

#### WARNING



Engine noise above 85 dB (A).

#### Risk of damage to hearing!

- Wear ear protectors.

#### CAUTION



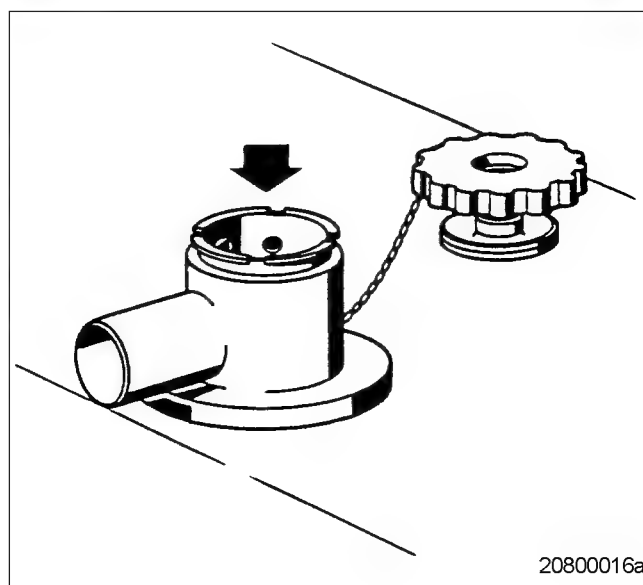
Cold coolant in hot engine can cause thermal stress.

#### Formation of cracks in components!

- Fill / top up coolant only into cold engine.

### Preparatory steps

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Remove plug screw from filling point on coolant line to intercooler.



20800016a

### **Filling charge-air coolant**

1. Fill treated coolant through filling line or through filler neck of coolant expansion tank until coolant level reaches marking plate.
2. Install plug screws of filling points with new sealing rings.
3. Check proper condition of breather valve, clean sealing faces if required.
4. Fit breather valve and close it.

### **Final steps**

1. Start the engine and operate it at idle speed for some minutes.
2. Check coolant level (→ Page 56).

## 7.9.5 Charge-air coolant pump – Relief bore check

### DANGER



Unguarded rotating and moving engine components.  
**Risk of serious injury – danger to life!**

- Take special care when working on a running engine.

### WARNING



Engine noise above 85 dB (A).  
**Risk of damage to hearing!**

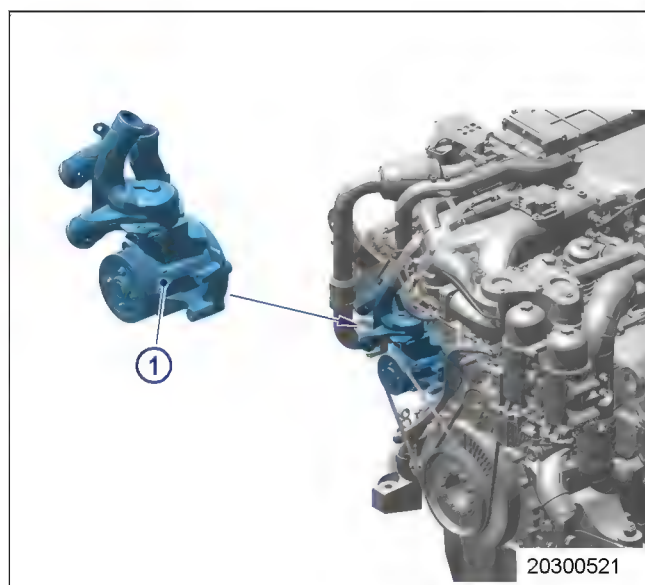
- Wear ear protectors.

### Charge-air coolant pump – Relief bore check

1. Check relief bore (1) for coolant discharge.
  - Permissible coolant discharge: Up to 0.1 ml per hour respectively 100 ml per 1,000 operating hours.

Result: If discharge exceeds the specified limits, contact Service.

2. If relief bore (1) is clogged:
  - Stop engine (→ Page 28) and disable engine start.
  - Clean relief bore (1) with wire.



## 7.10 Wiring (General) for Engine/Gearbox/Unit

### 7.10.1 Engine wiring – Check

#### Preconditions

- ☒ Engine is stopped and starting disabled.

#### Special tools, Material, Spare parts

Designation / Use	Part No.	Qty
Isopropyl alcohol	X00058037	1

#### Engine wiring – Check

1. Check securing screws of cable clamps on engine and tighten loose threaded connections.
  2. Ensure that cables are fixed in their clamps and cannot swing freely.
  3. Check that cable ties are firm, tighten loose cable ties.
  4. Replace faulty cable ties.
  5. Visually inspect the following electrical line components for damage:
    - connector housings;
    - contacts;
    - sockets;
    - cables and terminals;
    - plug-in contacts.
  6. (→ Contact Service) if cable conductors are damaged.
- Note: Close male connectors that are not plugged in with the protective cap supplied.
7. Clean dirty connector housings, sockets and contacts with isopropyl alcohol.
  8. Ensure that all sensor connectors are securely engaged.

## 7.11 Accessories for (Electronic) Engine Governor / Control System

### 7.11.1 Engine governor and connectors – Cleaning

#### Preconditions

- ☒ Engine is stopped and starting disabled.

#### Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Isopropyl alcohol	X00058037	1

Note: Always use test connectors to enter the connectors. Never use test leads for this purpose. Otherwise the contacts could be bent.

#### Engine governor and connectors – Cleaning

1. Remove coarse dirt from housing surface with isopropyl alcohol.
2. Remove dirt from connector and cable surfaces with isopropyl alcohol.
3. Check legibility of cable labels. Clean or replace illegible labels.

#### Cleaning severely contaminated connectors on the engine governor

- Note: Seal unused connectors with the supplied protective cap.
1. Release the latch and pull off connectors.
  2. Clean connector housings, connector socket housings and all contacts with isopropyl alcohol.
  3. When connectors, sockets and all contacts are dry: Fit connectors and lock them.

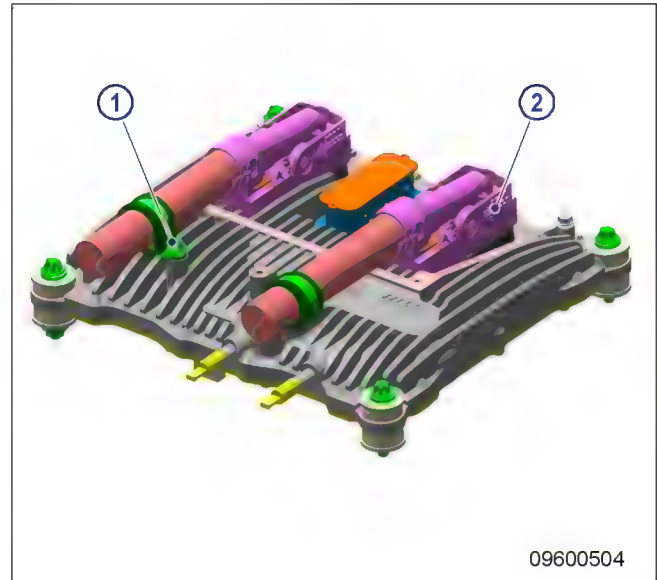
## 7.11.2 Engine Control Unit – Plug connection check

### Preconditions

- ☑ Engine is stopped and starting disabled.

### Checking Engine Control Unit plug connections

1. Check firm seating of all connectors on the Engine Control Unit. Make sure that the clips (2) are engaged.
2. Check firm seating of all screws (1) on Engine Control Unit cable clamps. Make sure that cable clamps are not defective.



## 8 Appendix A

### 8.1 Abbreviations

Abbreviation	Meaning	Explanation
A/D	Analog/Digital	Transformer: transforms sensor voltages into numeric values
ADEC	Advanced Diesel Engine Controller	Engine management system
AFRS	Air Filter Restriction Sensor	
ANSI	American National Standards Institute	Association of American standardization organizations
ATL	Abgasturbolader	Exhaust turbocharger (ETC)
ATS	Air Temperature Sensor	
BR	Baureihe	Series
BV	Betriebsstoffvorschrift	Fluids and Lubricants Specifications, MTU Publication No. A01063/..
CAN	Controller Area Network	Data bus system, bus standard
CDC	Calibration Drift Compensation	Setting of drift compensation in engine governor with DiaSys
CEL	Check Engine Light	1st function: Warning lamp (rectify fault as soon as possible) 2nd function: Read out fault codes
CKT	Circuit	
CLS	Coolant level sensor	Monitors coolant level
CPS	Coolant pressure sensor	Monitors coolant pressure
CTS	Coolant temperature sensor	Monitors coolant temperature
DDEC	Detroit Diesel Electronic Controls	Engine control system made by Detroit Diesel
DDL	Diagnostic Data Link	Diagnostic lines
DDR	Diagnostic Data Reader	Diagnostic unit
DIN	Deutsches Institut für Normung e. V.	At the same time identifier of German standards (DIN = "Deutsche Industrie-Norm")
DL	Default Lost	Alarm: Default CAN bus failure
DOC	Diesel Oxidation Catalyst	Oxidation catalyst upstream of the diesel particulate filter
DPF	Diesel Particulate Filter	
DT	Diagnostic Tool	Diagnostic unit
ECM	Electronic Control Module	Electronic control unit of the DDEC system
ECU	Engine Control Unit	Engine governor
EDM	Engine Data Module	Memory module for engine data
EEPROM	Electrically Erasable Programmable Read Only Memory	
EFPA	Electronic Foot Pedal Assembly	

Abbreviation	Meaning	Explanation
EGR	Exhaust Gas Recirculation	
EMU	Engine Monitoring Unit	
ETK	Ersatzteilkatalog	Spare Parts Catalog (SPC)
EUI	Electronic Unit Injector	
FPS	Fuel Pressure Sensor	Monitors fuel pressure
FRS	Fuel - Differential Pressure Sensor	
FTS	Fuel Temperature Sensor	Monitors fuel temperature
FWCP	Fire Water Control Panel	
GND	Ground	
HI	High	Alarm: Measured value exceeds 1st maximum limit
HIHI	High High	Alarm: Measured value exceeds 2nd maximum limit value
HP	High Pressure	
HT	High Temperature	
IDM	Interface Data Module	Memory module for interface data
INJ	Injector	
ISO	International Organization for Standardization	International umbrella organization for all national standardization institutes
KGS	Kraftgegenseite	Engine free end in accordance with DIN ISO 1204
KS	Kraftseite	Engine driving end in accordance with DIN ISO 1204
LED	Light Emitting Diode	
LO	Low	Alarm: Measured value lower than 1st minimum limit value
LOLO	Low Low	Alarm: Measured value lower than 2nd minimum limit value
LSG	Limiting Speed Governor	
N/A	Not Applicable	
LP	Low Pressure	
OEM	Original Equipment Manufacturer	
OI	Optimized Idle	
OLS	Oil Level Sensor	Monitors oil level
OPS	Oil pressure sensor	Monitors oil pressure
OTS	Oil Temperature Sensor	Monitors oil temperature
OT	Oberer Totpunkt	Top Dead Center (TDC)
PAN	Panel	Control panel
PIM	Peripheral Interface Module	
PWM	Modulated signal	
P-xyz	Pressure-xyz	Pressure measuring point, xyz specifies the measuring point designation
RL	Redundancy Lost	Alarm: Redundant CAN bus failure

Abbreviation	Meaning	Explanation
SAE	Society of Automotive Engineers	U.S. standardization organization
SD	Sensor Defect	Alarm: Sensor failure
SEL	Stop Engine Light	1st function: Warning lamp (stop engine and rectify fault) 2nd function: Read out fault codes
SID	System Identifier	
SRS	Synchronous Reference Sensor	TDC cylinder 1
SS	Safety System	Safety system alarm
TBS	Turbocharger Boost Sensor	Monitors charge-air pressure
TCI	Turbo Compressor Inlet	
TCO	Turbo Compressor Outlet	
TD	Transmitter Deviation	Alarm: Deviation in transmitter values
TPS	Throttle Position Sensor	
TRS	Timing Reference Sensor	
T-xyz	Temperature-xyz	Temperature measuring point, xyz specifies the measuring point designation
UT	Unterer Totpunkt	Bottom Dead Center (BDC)
VNT	Variable Nozzle Turbine	
VSG	Variable-Speed Governor	
VSS	Vehicle Speed Sensor	
WZK	Werkzeugkatalog	Tool Catalog

## 8.2 MTU contacts/service partners

### **Service**

Our worldwide sales network with its subsidiaries, sales offices, representatives and customer service centers ensures fast and direct support on site and the high availability of our products.

### **Local support**

Experienced and qualified specialists place their knowledge and expertise at your disposal.

For locally available support, go to the MTU internet site: <http://www.mtu-online.com>

### **24h hotline**

With our 24h hotline and the outstanding flexibility of our service staff, we are always ready to assist you - either during operation, for preventive maintenance, corrective work in case of malfunction or changed operating conditions, or for spare parts supply.

Your contact at Headquarters: [Service-support@mtu-online.com](mailto:Service-support@mtu-online.com)

### **Spare parts service**

Fast, simple and correct identification of spare parts for your drive system or vehicle fleet. The right spare part at the right time at the right place.

With this aim in mind, we can call on a globally networked spares logistics system

- a central depot at Headquarters, as well as decentralized depots among our subsidiaries, representatives and contractual workshops.

Your contact at Headquarters:

E-mail: [spare.parts@mtu-online.com](mailto:spare.parts@mtu-online.com)

Phone: +49 7541 908555

Fax: +49 7541 908121

## 9 Appendix B

### 9.1 Special Tools

#### Allen key, 5 mm

Part No.: F30002815

Qty.: 1

Used in: 7.1.1 Valve clearance – Check and adjustment (→ Page 37)

#### Barring device

Part No.: F6790714

Qty.: 1

Used in: 7.1.1 Valve clearance – Check and adjustment (→ Page 37)

#### Box wrench, 14 mm

Part No.: F30028346

Qty.: 1

Used in: 7.1.1 Valve clearance – Check and adjustment (→ Page 37)

#### Feeler gauge

Part No.: Y20010128

Qty.: 1

Used in: 7.1.1 Valve clearance – Check and adjustment (→ Page 37)

#### Ratchet

Part No.: F30027340

Qty.: 1

Used in: 7.2.1 Fuel system – Venting (→ Page 41)

#### Ratchet adapter

Part No.: F30027340

Qty.: 1

Used in: 7.3.1 Fuel filter – Replacement (→ Page 42)

Qty.: 1

Used in: 7.7.1 Engine oil filter – Replacement (→ Page 48)

#### Socket, 32 mm

Part No.: F30006120

Qty.: 1

Used in: 7.7.1 Engine oil filter – Replacement (→ Page 48)

#### Socket, 32 mm

Part No.: F30006120

Qty.: 1

Used in: 7.3.1 Fuel filter – Replacement (→ Page 42)

Steam jet cleaner	
Part No.:	-
Qty.:	1
Used in:	4.7 Plant – Cleaning (→ Page 30)
Torque wrench, 10-60 Nm	
Part No.:	F30510423
Qty.:	1
Used in:	7.3.1 Fuel filter – Replacement (→ Page 42)
Qty.:	1
Used in:	7.7.1 Engine oil filter – Replacement (→ Page 48)
Torque wrench, 20-100 Nm	
Part No.:	F30026582
Qty.:	1
Used in:	7.1.1 Valve clearance – Check and adjustment (→ Page 37)
Torque wrench, 4-20 Nm	
Part No.:	F30044239
Qty.:	1
Used in:	7.2.1 Fuel system – Venting (→ Page 41)
Qty.:	1
Used in:	7.3.1 Fuel filter – Replacement (→ Page 42)

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